INTERNATIONAL TREASURY MANAGEMENT SERIES

Managing currency risk using foreign exchange options

Alan Hicks

CRC

WOODHEAD PUBLISHING LIMITED

and

THE ASSOCIATION OF CORPORATE TREASURERS

Managing currency risk using foreign exchange options

THE ASSOCIATION OF CORPORATE TREASURERS

The Association is a professional body, formed to encourage and promote the study and practice of finance and treasury management, and to educate those involved in this field. It is the only UK professional body which concentrates and sets professional examinations exclusively on this subject. It is an independent body, governed by a Council of Members whose work is supported by a number of active voluntary committees.

The Association has approximately 3000 members and more than 1300 professionals enrolled on examination courses.

Since its formation in 1979, the influence of and contribution made by the Association has grown steadily. High educational standards have fed through into high technical standards. This has meant that, as an organization, the Association focuses not only on serving its members directly, but also representing them on relevant issues in the public domain. It has influenced proposals for regulatory change and promoted voluntary codes for wholesale market participants. It has also influenced changes in accounting and tax legislation. The Association has contributed to the corporate governance debate and aspects of competition policy, and has been consulted on and successfully contributed to many practical aspects of European Monetary Union. These messages are reinforced at conferences and in the publications it produces.

Managing currency risk using foreign exchange options

ALAN HICKS

CRC Press
Boca Raton Boston New York Washington, DC

WOODHEAD PUBLISHING LIMITED
and
THE ASSOCIATION OF CORPORATE TREASURERS

Published by Woodhead Publishing Limited and The Association of Corporate Treasurers

Woodhead Publishing Limited, Abington Hall, Abington
Cambridge CB1 6AH, England
www.woodhead-publishing.com

Published in North and South America by CRC Press LLC, 2000 Corporate Blvd, NW
Boca Raton FL 33431, USA

First published 2000, Woodhead Publishing Ltd, The Association of Corporate Treasurers
and CRC Press LLC

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library.

Library of Congress Cataloging in Publication Data
A catalog record for this book is available from the Library of Congress.

Woodhead Publishing ISBN 1 85573 491 5
CRC Press ISBN 0-8493-0873 9
CRC Press order number: WP0873

Cover design by The ColourStudio
Typeset by BookEns Ltd, Royston, Herts, England
Printed by TJ International, Cornwall, England

Contents

Preface xi
Acknowledgements xv

1 **Short history of foreign exchange options** 1

Development of interbank (over the counter) market 2
Simple option structures 3
The arrival of exotics 4
Corporate awareness................................. 4
Terms and conditions governing options 5
Supervision and regulation 5

2 **The basics** 6

Foreign exchange (FX) 7
Spot and forward FX 8
Option definition 8
Premium 9
Face value 10

Call and put 10
Exercise 11
Maturity (expiry) date and time 11
Option style 12
Strike 13
Intrinsic value 13

3 **Option characteristics** **16**
FX position 16
Long call (bought call) 18
Long put (bought put) 19
Call and put together (straddle) 20
Short options 21
Interim value of options 23
Underlying position 24

4 **The market-place** **26**
Over the counter (OTC) 26
Exchange listed options 31
Comparison (OTC versus exchange listed contracts) 36

5 **Put–call parity** **39**
Synthetic positions 39
Put-call parity: working example 43
Other synthetics 45
Interim values 46

6 **Option pricing** **47**
Black-Scholes 47
Input factors for pricing 48
Volatility 49
Components of price 51
Intrinsic value 51

Time value ... 52
Components of time value ... 53
Time value effects: non-linear nature ... 54
Time value effects: ATM versus OTM/ITM options ... 56
Time value adjustment through volatility ... 58
Pricing terms ... 62
Pricing systems ... 64
Pricing summary ... 66

7 Using options for hedging: simple ... 68

Calls and puts ... 68
Selling options ... 72
The risk reversal ... 74
Participating forwards ... 84
Seagulls ... 90
Designing a strategy ... 95
Risk manipulation ... 99

8 The delta and option replication ... 101

Understanding the delta ... 102
Delta hedging ... 105
Option replication ... 109

9 OTC market practice ... 113

Volatility quoting ... 114
Exercise procedure ... 125
Other practices ... 126
Corporate market ... 128
How to compare quotes using volatility ... 129

10 Bank relationships ... 133

The salesperson ... 133
The dealer ... 135
Is price all that matters? ... 137
Guidelines for good relationships ... 137

11 **Using options for hedging: intermediate** **140**

Compound options 141
Forward start options 144
Average rate options (AVROs) 145
Barrier options 151
Lookback (optimal) options 178
Basket options 179

12 **Using options for hedging: advanced** **181**

The digital (binary or bet) option 182
Exotic options in strategies 195

13 **Risk control** **208**

Interim value of options 209
Risk simulations 210
Software systems 215

14 **Documentation** **216**

History of option terms and conditions 217
Market preference: terms and conditions 219
Master agreements: summary 219
1997 international currency options market (ICOM) terms 220
Market practice 222
Schedule of 'Certain matters to be agreed' 229
The barrier option addendum 231
Impact of 1997 ICOM 233

15 **Counterparty credit risk** **235**

Background 235
Foreign exchange limits 236
Netting 238
Option counterparty risk factors 240
Margins 244

Master Agreement terms and conditions 245
Conclusion 245

Glossary of terms 247

Appendix I Currency codes 267

Appendix II London Code of Conduct 271

Appendix III Exchange contract specifications 273

Appendix IV International OTC market terms and conditions 275

Index 323

This page intentionally left blank

Preface

In today's world of high technology and sophisticated financial derivatives, many products are now available to eliminate or manage foreign exchange (FX) risk to meet the requirements of those exposed to exchange rate changes. Highly liquid and efficient markets, such as the FX options market, exist to disseminate FX risks amongst banks and other institutions.

Despite such advances in financial product diversification, companies continue to report that earnings have suffered owing to 'adverse exchange rate movements'. Every time a domestic currency appreciates, exporters bemoan the decline in profits and overseas orders and we are told how bad it is to have a strong national currency. Importers keep very quiet. When the domestic currency declines, importers complain about the increased cost of their products and point out the inflationary dangers of having a weak national currency. Exporters report record order books.

In this simple but realistic example, it can be seen that the exporters and importers have opposite FX risks and there is a mutual interest for one side to hedge their FX risk with the other. This is where the banks play an important part in being the market intermediary, in the same way as they take deposits from those with surplus cash and lend it to those with cash shortages.

Notwithstanding the above and the fact that more companies hedge FX risk than ever before, it is still commonplace to see a FTSE 100 company

report (large) loss of earnings owing to adverse exchange rate changes. One reason for the reluctance to hedge is the fear that an unhedged competitor may gain from a favourable rate movement, whilst a hedged company would not. Although the opposite is also true - a hedged company will gain (not lose) while the competitor loses - corporates know that shareholders will accept exchange rate losses as a circumstantial event and therefore have a ready-made excuse not to hedge and maintain the same financial risk stance as the competition. This is where the option, in its many forms, can play a major role - providing the protection needed whilst retaining the benefit of a favourable FX rate movement.

This book has been written with the corporate treasurer or finance director in mind. The objectives are twofold: firstly, to give a clear perspective of how FX options are derived from the underlying FX markets. Secondly, to give a clear understanding of the benefits, cost, risks and rewards associated with the various FX option strategies and how options can play a part in any company's FX risk management programme. Using examples and case studies, the corporate will be able to identify options products best suited to his or her own company needs and individual circumstances.

The early chapters are intended to be a gentle introduction to the option product so will suit those readers unfamiliar with options and the hedging of FX risk. The book then gradually builds in complexity, covering hedging strategies in three stages. Chapter 7 demonstrates simple option strategies which can be employed as a first step. Chapter 8 then provides an understanding of the delta principles, and Chapter 9 explains how the market uses and expresses these in practice in terms of volatility. Once these concepts are understood, the reader is then suitably placed to gain through improved bank relationships (Chapter 10) and move on to the more complex hedging structures in chapters 11 and 12. Exotic options, which have proven to be a very popular method of hedging FX risk, are discussed in Chapter 12. Many of the exotic options have been created to reduce or eliminate the premium cost and these are explained in detail. The book then concludes with chapters on risk control, documentation and counterparty credit risk.

Corporate examples are used throughout with both graphic and tabular representation of payout profiles under different scenarios.

FX options are traded in two distinct market-places: the very large and dominant over the counter (OTC), or interbank, market and those options traded on physical exchanges (such as the Philadelphia Stock Exchange and the Chicago Mercantile Exchange in the USA). This book concentrates on the OTC market where hedging can be more precisely defined and product diversification is unlimited, for example, exotic options. Unless otherwise stated, all references are to the OTC market practices.

Exchange contracts are analysed and a comparison with OTC is summarised in Chapter 4, The market-place.

Given the importance of the OTC market, a separate chapter is included on bank relationships (Chapter 10). Competition between banks for corporate business in options is intense which is good for the corporate in terms of price competitiveness, but it is important for the treasurer to understand that one bank's price may be different from another for more than obvious reasons. Specific examples are given and a set of guidelines is offered to assist corporate staff in dealing with bank counterparts, the objectives being to reduce errors from misunderstandings and to promote professionalism.

Most books on the subject of options concentrate on pricing theory - hundreds of formulae - and are written by academics, many of whom have no real trading experience or knowledge of market practice. This book concentrates on the practical application of options as experienced in the real world of foreign exchange and leaves pricing to one of the proven software packages available in the market-place - 'FENICS'. Although the famous Black-Scholes formula is reproduced in the text for reference, most of the mathematics in this book is of simple arithmetic.

Accounting for FX options has developed from the simple cost-based concepts of ten years ago and is now covered by various standards issued since then by the appropriate accounting boards such as the Financial Accounting Standards Board (FASB) in the USA and the Accounting Standards Board (ASB) in the UK. The growth in derivatives and the problems experienced with major losses by banks trading in such has resulted in the subsequent requirement for more control and visibility. Accounting standards are still evolving and there are now clear differences between countries (particularly if one compares the UK and the USA) and between financial institutions and others. Consequently, accounting for FX options is not covered in this book.

A glossary of terms is included (and can be found after Chapter 15) before the appendices. The wording used is mostly that of the British Bankers' Association in its booklet, *BBA Treasury Terminology 97*, as applied to foreign exchange and foreign exchange options.

The euro was instigated as a new currency on 1 January 1999. Rates of exchange between the component currencies (how many FRF to a DEM and so on) were fixed on 3 May 1998. Rates between the euro itself and the component currencies (how many FRF to one EUR, etc) were fixed at close of business on 31 December 1998. The 11 constituent currencies (ATS, BEF, EUR, ESP, FIM, FRF, IEP, ITL, LUF, NLG and PTE) will continue to be used alongside the euro for a period of three years. For the time being, sterling (GBP) will remain outside the euro despite Britain being a member of the European Union.

This creates a choice for any corporate outside the euro zone when dealing with Europe; for example, a UK treasurer may continue with the familiar exchange currencies and rates, say GBP/DEM at 2.80, or we can look

at GBP/EUR at 1.4316. With EUR/DEM irrevocably fixed at 1.95583, one expression is easily converted to the other. This book uses GBP/USD and EUR/GBP for the majority of examples and case studies in recognition that the European national currencies will cease to exist from 2002.

Finally, as the reader will already have noticed, this book uses the international professional market currency codes as devised by the Society for Worldwide Interbank Financial Telecommunication. SWIFT is a bank-owned co-operative used for secure payment and messaging in over 5200 banks in 135 countries with daily turnover in excess of $2 trillion. The FX and other professional markets have adopted the three-letter currency codes so EUR is the euro, DEM is Deutsche marks, CHF is Swiss francs, GBP is British pounds, USD is United States dollars and so on.

In quoting one currency against another (foreign exchange!) the 'certain for uncertain' method is used so, for example, USD/CHF represents the value of one US dollar (a certain amount) in terms of an uncertain amount of Swiss francs (the variable being the exchange rate, e.g. 1.2500 Swiss francs). However, in CHF/USD the rate of exchange will be different because the quotation method is the other way around - one Swiss franc being equal to so many US dollars, e.g. 0.8000 dollars (80 cents). One exchange rate is the reciprocal of the other.

Corporate treasurers are strongly encouraged to use the standard currency codes and the quotation method described above in all their currency dealings. This will help to avoid confusion, reduce the potential for errors and promote professionalism amongst market participants.

A full list of currency codes is provided in Appendix I.

Acknowledgements

The publication of LICOM terms and conditions in 1985 by the British Bankers' Association was generally accepted by banks worldwide and led to the rapid development of the OTC market. My thanks to the BBA for its kind permission to reproduce the 1997 ICOM (International Currency Options Market) Master Agreement Terms©. This publication carries copyright protection.

Thanks also go to the International Swap Dealers Association (ISDA), to the Financial Services Authority (FSA) and to Sandra Thompson at the Accounting Standards Board.

My thanks are also extended to Ross McDonald at the Bank of New York and to Gill Hirst at Crédit Agricole Indosuez for advice and assistance on current market practices and recent developments.

This page intentionally left blank

CHAPTER

1

Short history of foreign exchange options

The foreign exchange (FX) options market is relatively young and is still developing so a short history of where we have come from is worthwhile to give the reader some perspective.

The FX option is a true financial derivative - the risk/reward profile cannot be replicated in the underlying instrument (a forward FX transaction). This cannot be said for a currency *future* which is an exchange traded contract usually termed as being a derivative instrument. For some, particularly individuals, futures provide a convenient method of creating a similar risk profile to that of a forward FX transaction.

Thus futures have been around for some time in foreign exchange but options are a more recent development. Even before Black-Scholes,[1] the mathematics for option pricing had been available but it was the advent of personal computers (PCs) for pricing and risk management that made it possible for a market to develop.

Although there was limited trading of FX options between some banks (mainly in the USA and Switzerland) and their customers in the 1970s, the credit for instigating the market is usually attributed to the Philadelphia Stock Exchange (PHLX). In December 1982, the PHLX listed the first currency

1 The Black-Scholes formula published in 1973 currently forms the basis of most option pricing.

option contract in the USA - GBP against the USD - and followed this up with the listing of other currencies in 1983.The PHLX contracts were options on physical delivery, the same as in the FX market.

The largest futures exchange - the Chicago Mercantile Exchange (CME) - followed some time after the PHLX with the listing of an option on its existing currency future.This contract differed from the PHLX in that the option delivered into the currency future, rather than physical cash.

After a slow start, the listed currency options market in Philadelphia steadily grew in size, provoking interest amongst banks and their customers. For the banks, the PHLX market offered a way of offsetting option sales to their customers so the product was marketed as another, potentially better, way to manage FX risk.

As multi-national corporations and other entities open to FX risk started to use options, customer demand and competition between banks meant more and more banks felt obliged to offer the option product. With everybody hedging on the PHLX, the exchange saw an explosion of business to the point of well over 50% of transactions flowing from London banks alone in 1983. Other exchanges began to look at the product, resulting in the listing of the option on a currency future at the CME, another option variant on the LIFFE and even a PHLX look-alike on the London Stock Exchange! Both London contracts failed and were subsequently delisted.

Development of interbank (over the counter) market

Whilst the exchanges offered a way of hedging the bank's option business, there were some big flaws - the contracts on the exchanges were limited to just a few fixed maturity dates with exchange rates quoted in reciprocal terms[2] to those on the FX market.These two factors alone meant that bank business conducted with customers in regular FX terms with any expiry date could not be matched exactly on either of the two exchanges - there was a general mismatch resulting in possible risk of loss to the banks.

In 1984, in London, there were around eight banks actively trading in FX options. At a lunch organised by Fidelity Bank (the London branch of a Philadelphia-based bank), six banks agreed to make two-way (bid and offer) prices to each other, on demand, with an obligation to deal in at least one million US dollars, if price agreed. The (London) interbank, or over the

2 Exchange contracts in the USA were denominated in US$ per currency unit (e.g. Deutsche marks) which is opposite to that of the FX market except for GBP/USD.

counter (OTC), market was born and the seeds sown for the eventual demise of bank hedging on the exchanges.

Also, in 1984 FX market brokers started up options businesses to support the banks dealing OTC and the Bank of England published reporting guidelines for banks trading in FX options. At this point, only a few companies were using options to hedge or manage FX risk and those that were tended to be in Europe. There were very few in the UK.

The following year, 1985, saw the arrival of the London interbank currency options market (LICOM) terms and conditions that, during the ensuing years, became the world-wide standard for FX options traded over the counter. Although intended primarily for transactions between banks, LICOM quickly became the approved document for contracts between companies and their banks.

By 1987, interbank dealing in options had become very efficient through the technique of trading options in terms of implied volatility with spot FX delta hedges.[3] This enabled the OTC market to achieve exponential growth and reduce dealing spreads to corporate clients who were now beginning to use options as part of their foreign exchange risk hedging.

At this juncture, OTC business in terms of volumes transacted became larger than all the exchanges combined. Although both markets continued to expand over the ensuing years, the exchanges would never command the market share of the early days and now they account for less than 1 per cent of all options transacted.

Simple option structures

Options on markets other than foreign exchange have existed on various exchanges for many years. During this time, the popular option combinations were classified under certain names such as straddles, strangles, butterflies and the like.[4] Unfortunately, many of these structures were unsuitable for hedging purposes - they were speculative in nature - and were of little use to corporate users.

In the 1980s, banks started to market simple option combinations for corporate hedging purposes and came up with their own brand names for them - the cylinder was one of the first popular strategies. This very simple option combination proved to be very popular with the corporate because

3 Volatility trading and delta hedging are fully described in later chapters.

4 Simple option combinations are described in later chapters and all are listed in the Glossary of terms.

it was usually constructed as zero cost - effectively no premium payment was involved.

Unfortunately, each bank had its own name for the same strategy - a range forward from one bank was a cylinder from another and a collar from someone else! Over the years rationalisation has taken place and the market today consists of the inherited exchange strategies plus a small selection of OTC hedging structures. The old cylinder ended up as a risk reversal!

The arrival of exotics

During the formative years of 1983-7, the odd exotic[5] option was transacted in the form of a compound option (an option on an option) or maybe an average rate option. However, the arrival of the barrier, or trigger, option in the late 1980s spurred the development of a whole range of such products that are now available. In most cases, exotic options have been devised through corporate demand to reduce premium expenditure and/or to customise the option to fit particular conditions and requirements.

The barrier option was the first popular exotic used for corporate hedging as it offered both premium reduction and the possibility of bettering the traditional FX hedging tool - the foreign exchange forward.

Corporate awareness

Foreign exchange risk is unusual in that many companies tend to ignore it completely or are not aware of the risks involved. Corporations, who would not dream of taking risks outside their chosen business ventures and insure themselves against all manner of events, may still leave foreign exchange rate movement in the lap of the gods (or the FX dealers!). How strange this is when one considers that, traditionally, foreign exchange has been amongst the most volatile of all markets.

Corporate use of options has been slow to develop during the first years of option development because of this lethargy. In other words, the corporate use has been restricted to those companies already using the FX markets to hedge. A high percentage now include options as part of their FX risk man-

5 Exotic options have payout scenarios that differ from normal options according to various other factors or conditions. True exotics cannot be replicated by combining regular options – they are option derivatives.

agement but there is still a very long way to go before companies 'insure' themselves against adverse rate movement by buying options.

Terms and conditions governing options

In the OTC market, the original LICOM terms of 1985 were replaced by the international currency options market (ICOM) in 1992 at the same time that ISDA (originally the International Swap Dealers' Association, but now renamed International Swap and Derivatives Association) included currency options in their published terms and conditions.

Both ICOM and ISDA take the form of a Master Agreement whereby the terms and conditions relate to multiple transactions with a given counterparty. Companies doing business in FX options with banks were usually asked to subscribe to either of the above, or to a bank's individual terms and conditions. This practice has continued and is now in operation worldwide.

Supervision and regulation

Regulation varies around the world but is normally on the same basis as that for foreign exchange trading - supervision by the local central bank (e.g., the Federal Reserve Bank in the USA) or some other government agency such as the Financial Services Authority (FSA) in the UK. The Bank of England's supervisory responsibilities were passed to the FSA on 1 June 1998.

Aside from central bank supervision, FX and option dealers abide by a code of conduct issued by the Committee for Professionalism of the ACI (Association Cambiste Internationale - the Financial Markets Association) - the international trade association that encompasses foreign exchange markets. Although this code is used in many national financial markets, there are some central banks that have developed their own national documents. There are around 20 countries which have done this including the UK where the FSA publish *The Grey Paper* (the regulation of the wholesale cash and OTC derivatives markets in sterling, foreign currency and bullion) which sets out the FSA's approach to the regulation of these markets and firms.

The London Code of Conduct (the Code) sets out the conduct of business standards that the FSA expects all participating firms and their employees to maintain.

CHAPTER

2

The basics

Options are available on many traditional 'physical' products such as bonds, equities, commodities (e.g. gold, silver, coffee, wheat and other agricultural products) and foreign exchange (currencies). With the advent of financial futures,[6] options are also available on futures where delivery results in a future contract rather than cash.

In all cases, the essential requirement for an option is constant - volatility in the underlying product. After all, if there is no volatility, there is no risk of price change and consequently no need for an option. In fact, the price for such an option would be at the same level as the underlying, i.e. the option cost would be zero. As FX markets have traditionally been very volatile, the FX option is a logical product to use to cover FX exposure.

6 A financial future is a contract (usually traded on an exchange) where the price is agreed now but delivery of the financial instrument (e.g. a 3-month USD 1 000 000 deposit or a 30-year bond or the exchange of currencies) is on a date in the future.

Foreign exchange (FX)

This book is all about options on foreign exchange so a basic understanding of FX is essential to comprehend the derivative. The definition for foreign exchange is:

> A contract to exchange a fixed amount of one currency for another at an agreed rate of exchange on a date in the future.

The FX market is unique in that it is the only market where both sides of the exchange are forms of money - all other markets are the exchange of money for something else. This rudimentary statement is made because FX can be somewhat confusing to readers not familiar with the way the market works and the fact that there are two different methods of quoting the rate of exchange between two currencies. Knowing which way round to quote can be quite perplexing when neither is the local, or accounting, currency.

To help avoid such confusion, this book will refer to currency pairs and always quote in the certain for uncertain method. For example, EUR/GBP represents the value of one euro (a certain amount) in terms of an uncertain amount of pounds sterling (the variable being the exchange rate, e.g. GBP 0.7000 or 70 pence). However, in GBP/EUR the rate of exchange will be different because the quotation method is the other way around - one pound being equal to so many Euros, e.g. 1.4286. One exchange rate is the reciprocal[7] of the other.

Certain	Uncertain	FX rate expression
EUR	GBP	0.7000
GBP	EUR	1.4286

Example:
One corporate wishes to buy EUR at 0.7000 (EUR/GBP) and another wishes to sell GBP at 1.4286 (GBP/EUR). These transactions are the same.

Foreign exchange dealing is further complicated by the absence of an obvious commodity that is the dealing unit. In all other markets, the dealt commodity is evident - shares, gold, coffee, wheat, potatoes, pork bellies, treasury bills, eurodollars or whatever - but in FX one can deal in either of the two currencies. It is just as easy to buy EUR (and therefore sell GBP) as it is to sell GBP (and therefore buy EUR) which, of course, is exactly the same

7 0.70 = 1/1.4286 and 1.4286 = 1/0.70.

transaction. The interbank dealers usually stick to market conventions and use one currency as the dealing unit within a given pair but customers - especially corporate clients - deal in either.

So, to recap, these are two basic rules to use in all examples in this book:

1. The rate quotation method for any currency pair is one unit of the certain currency (always on the left-hand side) is equal to so many (variable) units of the uncertain (always on the right-hand side).
2. The dealing currency may be either currency within a pair.

In dealing with FX options, it is essential that these basic rules be understood.

Market conventions will be used throughout to reinforce the practical nature of this book so, for example, GBP/USD will always be the rate method applied, never USD/GBP - although dealing may be in GBP or USD.

Spot and forward FX

FX transactions are either spot or forward. These terms refer to the delivery, or settlement, date whereby the exchange of currencies takes place. They normally carry different rates of exchange. In most currency pairs, spot is two business days from the transaction, or deal, date. So, if a spot dealer enters into a FX contract today, and today is Friday, then the spot date is next Tuesday (four calendar days from now). The dealt spot FX rate will apply to the contract.

Forward FX transactions are for settled on dates beyond the spot date - three business days onward. If a forward dealer enters into a one-week forward contract, delivery will take place one week over the spot date - a week next Tuesday (11 calendar days from trade date) in the above example. The dealt forward FX rate will apply to the contract. A forward rate of exchange can be calculated from the spot rate and the interest rate differential of the two currencies concerned.[8] In FX options, the underlying contract (reference rate) is the forward FX rate (not the spot rate), but more on this later.

8 The forward FX rate is *not* the market's expectation of the future value of spot.

Option definition

The definition of an option is:

> The holder (buyer) of an option has the right, but not the obligation to exchange a fixed amount of one currency for another at a fixed rate of exchange on a date in the future.

Currencies, amounts, rate and date are all predetermined. From the option buyer's perspective, this definition is basically the FX definition with 'the right, but not the obligation' added.

Example:
A UK importer of materials priced in USD holds an option to buy USD 1000000 at GBP/USD 1.60 (against selling GBP) in one month's time when payment of invoice for like amount is due. There is no obligation to buy USD at 1.60 - if the importer can obtain a better rate from the market in a month's time, the option can be ignored.

Note: Before the advent of the option derivative in foreign exchange, an option used to refer to a regular forward FX transaction where the customer (e.g. corporate) could choose to deliver the sold currency (and take delivery of the bought) on any day between two pre-agreed dates. This was nothing more than a simple facility granted by the bank to allow for customer uncertainty on currency cash flow. This type of FX option has no relevance to the subject matter of this book.

Premium

> In consideration of receiving the option right, the buyer pays to the seller (sometimes called the writer) a fee known as the premium.

The premium is paid on the spot date[9] prevailing in the FX market for that currency pair and represents the maximum that can be lost by the buyer and therefore also represents the maximum profit to the seller. The premium is usually paid in the dealing currency but either of the pair will suffice.[10]

The premium, being the cash value of the option, also represents the

9 Exchange traded options do not reference the underlying FX market practices and have fixed rules for premium payment – e.g. next day.

10 It is also possible to arrange payment of premium in a third currency by converting at relevant spot rate.

price of the option. However, prices can be quoted in many ways - for example as a percentage of face value - but more on pricing in a later chapter.

Example:
A UK importer of materials priced in USD purchases one-month option to buy USD 1000000 (against selling GBP) at the current spot rate of GBP/USD 1.60 for 2%. The company pays premium £12500 ($20000 at 1.60) to the seller, value two business days from now (spot value).

Face value

This is the predefined fixed *amount* of currency to be potentially exchanged. This is simply the size of the option contract and does not represent the option value (premium). Exchange markets deal in numbers of contracts whereas OTC deals in amounts of currency.

Example:
A UK importer of materials priced in USD purchases one-month option to buy USD (against selling GBP) with a face value of $1000000 to cover future invoice payment.

Call and put

Options are split into two types:

1. *Call* - the right to *buy* a specified currency.
2. *Put* - the right to *sell* a specified currency.

This means that, in the currency pair EUR/GBP, a call option on the euro is also a put option on sterling. If the option holder takes up his/her right to buy EUR, payment has to be made in GBP - 'selling' GBP. Likewise, the EUR put is also a GBP call in this currency pair.

	Buy	Sell
Call	EUR	GBP
Put	GBP	EUR

In view of the potential confusion, the call and put currencies should be clearly defined when entering into option transactions. While it is perfectly

acceptable to ask for a euro call against sterling, it would be better to ask for a call on euro, put on GBP.

Example:
A UK importer of materials priced in USD purchases one-month option USD 1 000 000 call (GBP put) to cover future invoice payment.

Exercise

The buyer of an option always has the right to take delivery of the exchange, or not. If the decision is to take delivery, the buyer must notify the seller of this decision by 'exercising' his (or her) right to delivery. Hence the exercise of an option is effectively the cancellation of the option and the creation of a FX transaction, value spot. The rate of exchange being at the option strike price (strike is defined after option style, below).

Example:
A UK importer of materials priced in USD holds a GBP/USD 1.60 USD 1 000 000 call (GBP put) to cover payment of invoice due now (spot value). Current FX rate is 1.55 so company exercises option by contacting the seller and buys $1 000 000 for cost of £625 000 by creation of a normal spot FX contract (except the rate is 1.60 from the option exercise). Non-exercise of option would mean paying £666 666.67 in the current spot market at 1.55 ($1 000 000/1.55).

Options are only exercised if it is beneficial to do so. It is unlikely that someone would exercise an option where the currency could be bought (call option) or sold (put option) at a better level in the prevailing spot market. Options that are not exercised expire worthless.

Example:
Using the same case as above, but with the current FX rate of 1.65, the company ignores the option (expires worthless) and buys $1 000 000 for cost of £606 060.61 in spot market. Exercise of the option would mean paying £625 000 ($1 000 000/1.60).

Maturity (expiry) date and time

All options have a predetermined life span that expires on the given date. Although exercise can only take place at maturity (for European-style

options, see below), options can be bought or sold on any business day before the maturity date.

Each option will have a specific expiry time on the maturity date, depending on where the transaction originated. Sometimes called the 'cut-off' time, expiry occurs at 10 am New York time (generally 3 pm, London time) for Europe and the Western hemisphere. In Asia, it is 3 pm Tokyo time with certain countries offering their own local cut-off times, usually at 3 pm (e.g. 3 pm Sydney). Unless otherwise stated, 10 am New York time is standard for all transactions during European and USA business hours, although any time may be requested to suit individual circumstances.

Example:
A UK importer of materials priced in USD purchases one-month, 10 am NY cut-off time GBP/USD 1.60 USD 1000000 call (GBP put) to cover future invoice payment.

Option style

Options may be described as either:

1 *American* - the holder may exercise on any business day during the option's life.
2 *European* - the holder may only exercise on the last day (maturity date).

Example:
A UK importer of materials priced in USD purchases a European one-month GBP/USD 1.60 USD 1000000 call (GBP put) to cover future invoice payment.

Whether American or European, delivery would be for value spot from exercise date for over the counter (OTC) options and at other (usually slightly longer) periods for exchange-listed options. OTC and exchange-listed options are described in more detail in Chapter 6.

In the OTC market, American-style options are very rarely seen although some exchanges still list such contracts.

Much has been written on the subject of pricing American-style options and the theorists have had a field day with trying to come up with the right mathematical model. Ignore this, as far as FX options are concerned, and be content to know that American-style options can never be cheaper than

European.[11] It is for this reason, alone, that the American-style option has all but disappeared from FX options market-place.

Note: The terms American and European are sometimes used to describe the two different ways of quoting FX rates similar to this book's usage of the more descriptive terms certain and uncertain. Used in this context, the terms American and European have no relevance to option exercise - they are just another unfortunate use of the terms!

Strike

The predetermined, chosen rate of exchange at which exercise takes place.

The strike (also known as the strike price or strike rate) is usually chosen at a level close to the current FX spot or forward rate but may be at any reasonable level.

Example:
A UK importer of materials priced in USD purchases a one-month USD 1 000 000 call (GBP put) with strike of 1.60 (GBP/USD) to cover future invoice payment.

The price (premium) of an option is very sensitive to the relationship of the strike to the current spot rate (see Chapter 5). Some corporate buyers prefer to set the strike at a predetermined level of premium expenditure.

Intrinsic value

The difference, if positive, between the strike price and the underlying FX rate.

The underlying FX rate for European-style options is the forward rate that coincides with the option's maturity date (when exercise of the option may take place). For American-style options, the FX spot rate is relevant.

11 American-style options are more expensive than European ones where potential exercise of the option results in receiving the higher yielding, and paying the lower yielding, currency.

Intrinsic value represents the value if exercised, usually expressed in the uncertain currency terms.

Example 1:
A UK importer of materials priced in USD holds a European USD 1 000 000 call (GBP put) struck at 1.60 (GBP/USD) to cover payment of invoice due now (spot value). Today is the option maturity date and current FX rate is 1.55, so option is beneficial to exercise (better to sell £ / buy \$ at 1.60 than at 1.55). Intrinsic value is \$0.05 or 5 cents.

If current spot was 1.65, the same option would not be exercised and have zero intrinsic value. If the option was a USD put (GBP call) with same strike of 1.60, then intrinsic value would be 5 cents from 1.65 – 1.60 (better to buy £ / sell \$ at 1.60 than at 1.65).

Example 2:
One week ago, a UK importer of materials priced in USD purchased a European one-month USD 1 000 000 call (GBP put) struck at 1.60 to cover future invoice payment. Current spot rate is 1.6010; forward FX rate for the option delivery date (two business days after expiry date) is 1.5970. This option has intrinsic value of \$.0030 from 1.60 (strike) - 1.5970 (forward FX rate) even though the spot rate is higher than the strike (i.e. option would not be exercised if today was the expiry date). The underlying rate for European options - the forward rate - is always used to value such options.

The price (premium) of an option will reflect the full amount of any intrinsic value and this direct relationship is further discussed in Chapter 5.

The following are explanations of some jargon associated with intrinsic value:

- Deep in the money - an option with very high intrinsic value.
- In the money (ITM) - an option that has intrinsic value.
- At the money (ATM) - an option with a strike similar to the underlying FX rate.
- Near the money - an option with a strike close to the underlying FX rate.
- Out of the money (OTM) - an option with no intrinsic value.
- Far out of the money - an option with very low probability of acquiring intrinsic value.

The following are some examples of intrinsic value:

Underlying FX rate	GBP call (USD put) Strike – 1.60 (GBP/USD)		GBP put (USD call) Strike – 1.60 (GBP/USD)	
1.5000	0	Far OTM	0.1000	Deep ITM
1.5500	0	OTM	0.0500	ITM
1.6000	0	ATM	0	ATM
1.6500	0.0500	ITM	0	OTM
1.7000	0.1000	Deep ITM	0	Far OTM

CHAPTER

3

Option characteristics

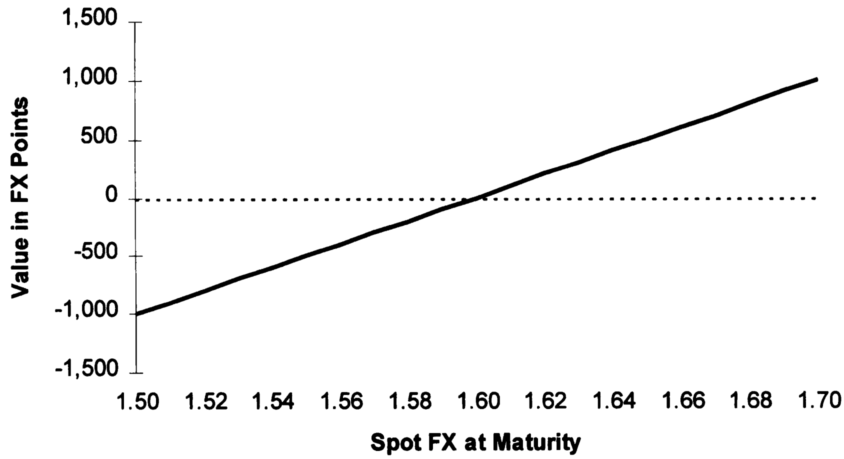
Option characteristics are best described graphically in what are known as payout or payoff diagrams that give a picture of the profit/loss (or risk/reward) profiles at different levels of spot FX, at maturity. But before we move on to them, let us take a look at the underlying instrument - the foreign exchange position - and some more market related jargon.

FX position

In FX, there are only two possible things one can do - either buy or sell a particular currency against another. Buying means going 'long', selling means going 'short' the currency in question. Of course, we know that buying one currency is also selling the other, so a long position in one currency is a short position in the other (within a currency pair).

For example, Fig. 3.1 represents the payout profile for a long GBP (short USD) position in GBP/USD or cable[12] at 1.60. Such a position can be established in many ways but here are two examples:

12 The FX market has established jargon for certain currency pairs. Cable dates back to an era when the GBP/USD rate between London and New York was determined by the use of an overnight cablegram between banks in those centres. It is considered professional to use this term in FX dealings.



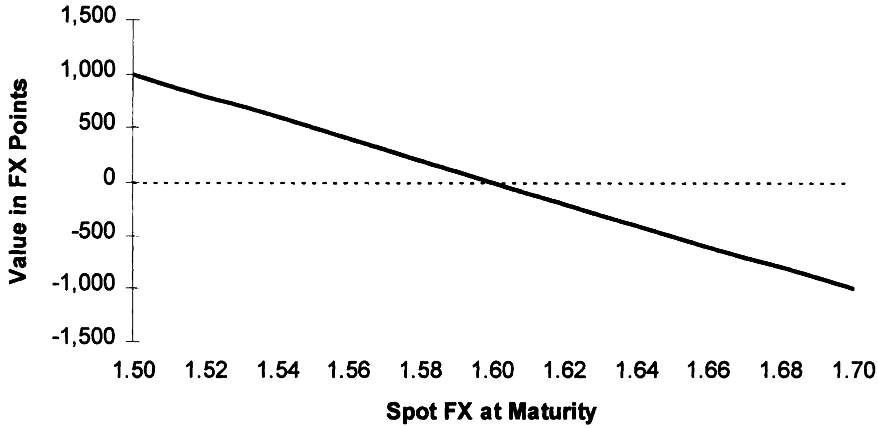
3.1 Long FX position - long GBP/short USD FX at 1.60.

1 A currency speculator buys GBP against USD for delivery on a date in the future.
2 An importer in the UK contracts to purchase goods priced in USD. The importer is short of the USD needed to buy the goods but he/she is holding sterling - short USD and long GBP.

The first example is speculative - the buyer is looking for a rise in the cable rate in order to sell back the GBP and make a profit - buy low and sell high as with any other investment.The second example is more interesting - the prime transaction is the purchase of goods priced in USD - and we can assume that the importer is looking to sell the goods in the UK as the profit motive, not to gain from a possible rise in cable. In this case the FX position of being long GBP in GBP/USD has *arisen* from another transaction but the risk is identical to that of the speculator in example 1. To negate the unwanted FX risk, the importer would need to *sell* GBP (buy USD) as the *hedging* strategy.

The graph in Fig. 3.1 is symmetrical in that profit and loss is equal and opposite, i.e. there is a 50:50 chance of profit or loss with unlimited parameters. Note that the 'Y' axis shows the position value (profit/loss) in FX points[13] which represents 100ths of a US cent so 200 points is equal to 2

13 FX points are used extensively in the FX market as the expression of the numbers being quoted and dealt. For example, in cable, spot might be 1.6050 (bid), 1.6055 (offered) = 1.6050–55 but the market quotes and deals only in the points value = 50–55, the 'big figure' (1.60) being known to all. In this example, the cable spread (bid–offer) is thus 5 points.



3.2 Short FX position - short GBP/long USD FX at 1.60.

cents, or $0.02 in the cable rate. Hence a move up in the rate from 1.60 to 1.62 is 2 cents or 200 points, profit.

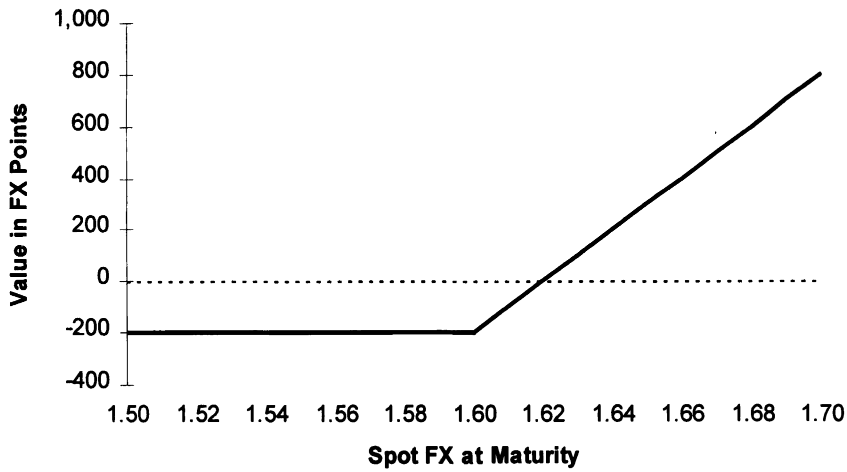
Figure 3.2 represents the second of the two possible strategies in FX - the short - showing a sold GBP position against USD.This time profit is made on a declining cable rate that might be the objective of a speculator or someone investing in USD as an asset.[14] It might also be the position of an exporter in the UK who receives payment in USD (long USD) who ultimately needs to convert to GBP.

Having covered the two FX positions, we can now move on to options where we can go long and short in both calls and puts giving us four basic possibilities or strategies.The first is the long, or bought, call.

Long call (bought call)

The big difference between options and the underlying FX is that long, or bought, options have the loss limited to the premium paid whilst retaining the unlimited upside potential.This fact creates payout diagrams that are not symmetric, but asymmetric and are often referred to as hockey stick diagrams. For example, the profit from holding a GBP call (USD put) such as in Fig. 3.3 arises from an increase in the value of the cable rate whereas loss is

14 'Speculation' is usually deemed to be an unsavoury practice whereas 'investment' is not.There is no difference in terms of the risk/reward profile so it is just a matter of perception.



3.3 Long call - bought GBP call (USD put), strike 1.60, premium 200 points ($0.02).

Profit potential is unlimited but loss is restricted to amount of premium paid of 2 cents (200 FX points). From a speculative point of view, the break-even is 1.62 which is the strike plus premium (1.60 + 0.02).

limited on a fall (to the amount of premium paid) and might suit the more cautious speculator.

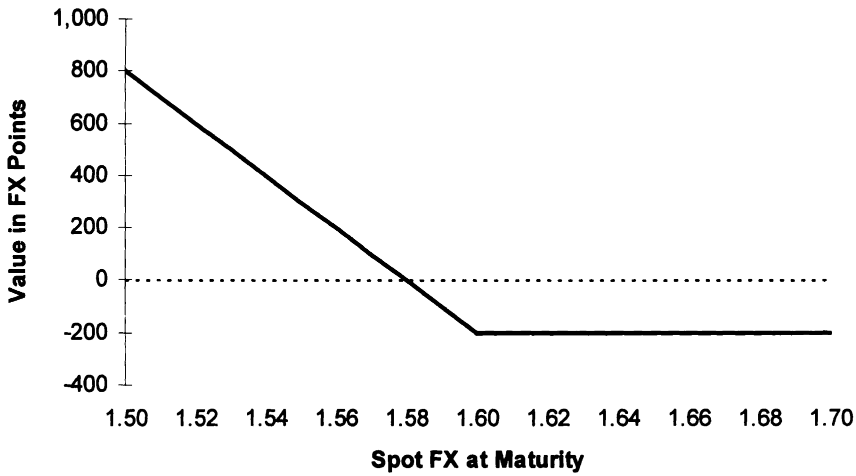
The fact that the long call benefits from a rise in GBP means that it can be used to counteract an opposite position - that of being short GBP. Thus the purchase of this option would suit a corporate institution wishing to hedge against the rise in value of sterling, for example, an exporter in the UK with receivables in USD.

Chapter 7 is devoted to hedging using simple option strategies such as the long call.

Long put (bought put)

In the long put, the profit is realised if sterling goes down but loss is limited if the pound goes up. Such a strategy might suit the more cautious speculator who views a decline in the cable rate as a likely event but does not want the unlimited losses of a straight short FX position, should he/she be wrong in their view. Alternatively, the purchase of a GBP put (USD call) such as in Fig. 3.4 would suit the corporate wishing to protect against the fall in value of sterling against USD, for example, a UK importer with payables in USD.

Chapter 7 gives an example of using a long put as a hedging strategy.



3.4 Long put - bought GBP put (USD call), strike 1.60, premium 200 points ($0.02).

Profit potential is unlimited but loss is restricted to amount of premium paid of 2 cents. From a speculative point of view, the break-even is 1.58 which is the strike less premium (1.60 – 0.02).

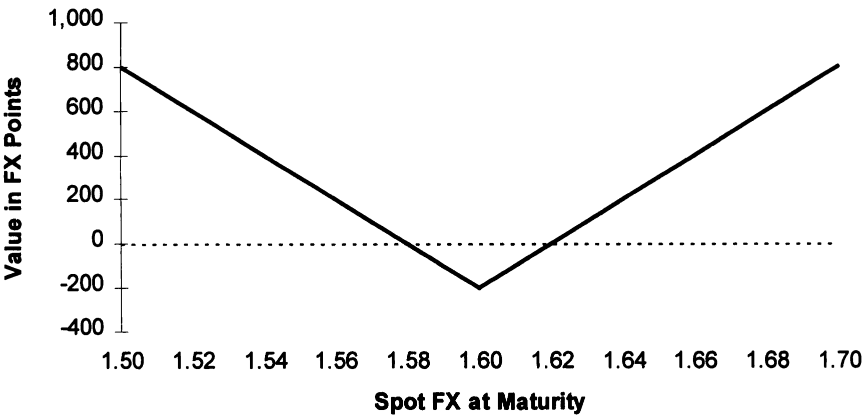
Call and put together (straddle)

The simple benefits of buying either a call or put option have been described above. We can also sell options but, before looking at short calls and puts, it is worthwhile demonstrating what can be achieved by combining options.

The simple combination of calls and puts can result in some very interesting strategies with payout diagrams that are impossible to achieve in the underlying FX market. The most simple option combination - and the most popular - is buying (or selling) both a call and a put option at the same time. A bought call and bought put with the same strike, amount and maturity is called a long straddle and can be represented by merging Fig. 3.3 and Fig. 3.4 to produce Fig. 3.5.

The diagram in Fig. 3.5 would be impossible to achieve in the underlying FX market in that the position profits from a movement in *either* direction of the FX rate. A straddle is normally used as a speculative instrument where movement of the underlying FX rate is expected but direction of the movement is uncertain. The cost is high (two premiums) hence a strong movement in the spot rate is required to recoup the premiums expended before the profit region is encountered.

Given that the direction of rate movement is of no consequence, the straddle is of no use as a hedging tool but is invaluable to option dealers as



3.5 Long straddle - bought GBP call (USD put), strike 1.60, premium 200 points ($0.02). Bought GBP put (USD call), strike 1.60, premium 200 points ($0.02). Total premiums = 400 points ($0.04).

Profit potential is unlimited in either direction of spot movement but loss is still limited to total premiums paid of 400 points. From a speculative point of view, the break-even is either 1.56 or 1.64 being the strike plus or minus total premiums.

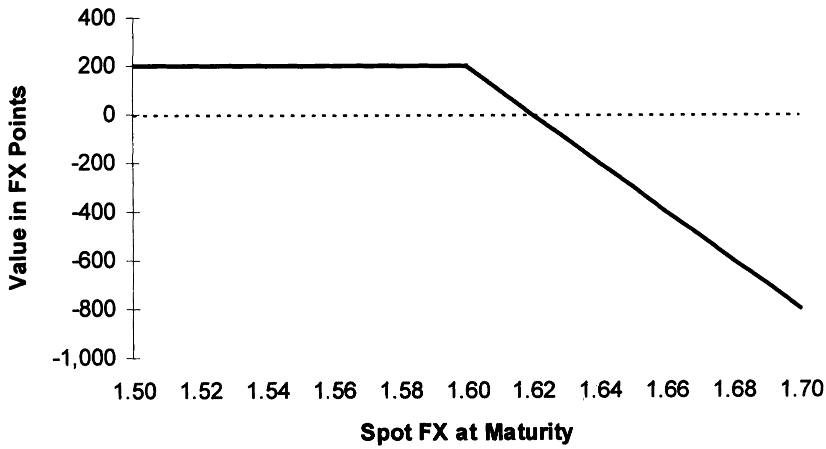
an instrument of volatility. We will return to the straddle and describe more simple option combinations in later chapters.

Short options

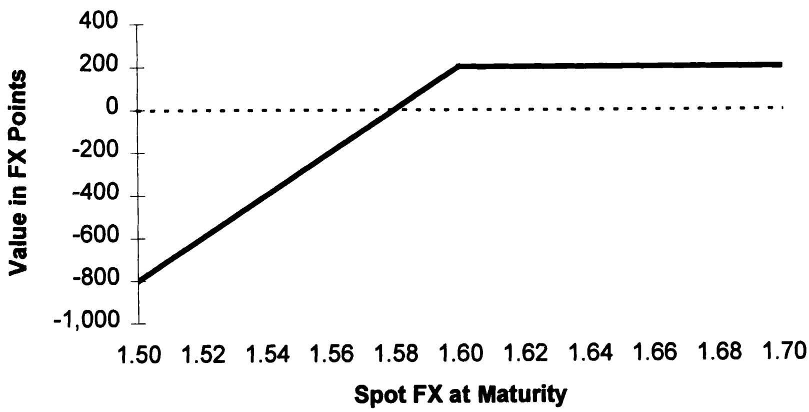
The options described so far have been from the perspective of the buyer, but options may be sold as well as bought. In the case of seller, the maximum return is the premium of the option even though the potential FX loss is unlimited. Note that Fig. 3.6 is the reciprocal of Fig. 3.3 (long GBP call) and that Fig. 3.7 is the reciprocal of Fig. 3.4 (long GBP put).

Writing (selling) options is often likened to underwriting an insurance policy in that a profit is made equal to the premium received if 'nothing happens'; i.e. the option is not exercised. In Fig. 3.6 (short GBP call/USD put) this would be with spot at or below 1.60 on maturity of the option. If, on the other hand, spot is above 1.60 the holder (buyer) will exercise the option resulting in a reduction of profit to 1.62 (the break-even rate) and a loss above that level equal to the difference between spot and 1.62. There is no upper limit to spot so the potential loss is unlimited.

So, from a speculative viewpoint, selling options to receive a small premium but with the possibility of unlimited losses is dangerous and not



3.6 Sold call - sold GBP call (USD put), strike 1.60, premium 200 points ($0.02). Profit potential is limited to the premium received and at maximum with spot at 1.60 or below. Break-even is at 1.62.



3.7 Sold put - sold GBP put (USD call), strike 1.60, premium 200 points ($0.02). Profit potential is limited to the premium received and at maximum with spot at 1.60 or above. Break-even is at 1.58.

for the unwary. In fact, the FX market is well known for sudden, violent movements. So, why does anybody sell options (although someone has to sell options otherwise there can be no buyers)?

There are two basic answers to this question. Firstly, it is possible to hedge sold options by buying (for sold call) or selling (for a sold put) the underlying currency using one or more methods, such as delta hedging.[15]

15 Delta hedging is a theoretical (mathematical) method employed by all banks trading in FX options and this principle can be applied for corporate use as a hedging tool through option replication described in detail in Chapter 8.

Secondly, selling options to gain the premium income can be used in cases where the writer already has the underlying currency position and can therefore always make delivery against any potential exercise, the so-called 'covered writing'. The first answer - hedging - lies in the realms of the banks but the second - covered writing - can be a useful tool for corporate users.

Corporate selling of options can be viewed as 'income enhancement'.

Example:
Assume that a US company has a balance of sterling in an account (earning interest) valued at a current rate of GBP/USD 1.60. The company intends to convert to USD at some point but probably not until the end of the financial year in, say, three months' time. The treasurer could sell a one-month 1.60 GBP call (USD put) for 200 $ points or 2%. The premium received is taken up-front as income with the worst scenario being that the company may have to sell the GBP to buy USD at 1.60 - the original rate - but only if the buyer exercises when spot is above 1.60. The negative side is that the company would give up the benefit of being able to convert to USD at a higher rate if spot is above 1.60 on maturity. If spot is below 1.60, the option would not be exercised and would expire worthless; the full negative effect of converting to USD at a lower level would be felt but offset to a limited degree by the premium received.

Note that the company sold the option for only one month rather than the three months to year-end. A shorter period was chosen on the assumption that the balances might be needed unexpectedly, i.e. the reason for leaving them in the account in the first place. The treasurer could, of course, write the option for any period of his or her choosing and, in the example, would probably sell another one month after the first option had expired, assuming that no exercise had taken place. If it transpired that the GBP balances were needed for conversion before the option matured, the treasurer would simply repurchase the option and sell the GBP at spot (and therefore buy USD).

Note that in this example, the company's position is long GBP (cash) and short the GBP call (potential sale of GBP). This position produces a situation that is identical to a short GBP put known as a synthetic short put, but this is covered in more detail in the next chapter.

Interim value of options

All the aspects discussed so far have been on the basis of the option value at maturity for a given level of the spot FX rate at that time. Options can be

bought and sold freely at any time, in which case the value will differ significantly at a given exchange rate (compared to the same rate at maturity) according to the amount of time value[16] inherent in the option's price (premium) at the interim point.

For example, a six-month option's value after two months will depend on the value of a four-month option at that point, which will be:

1 The level of the underlying FX rate - the four-month forward rate (not spot).
2 The time value element attached to a four-month option.

Viewpoint:	Value of option depends on:
At maturity	*Spot rate* (to give intrinsic value)
Interim	*Forward rate* (to give intrinsic value) plus Option *time value* for remaining term

The interim value of options and the *potential value* over time are key components in the risk management of options and the assessment of whether an option used for hedging purposes is performing satisfactorily. Such issues are discussed in Chapter 13, Risk control. Time value is explained in Chapter 5.

Underlying position

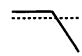
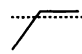
As we know, there are only two possibilities in the foreign exchange market - buy (go long) or sell (go short) of a particular currency. In options, we have the choice of being long or short in both calls and puts - a total of four possibilities - which we can refer to as the four building blocks.

Figure 3.8 shows the option positions (long and short) and gives the option characteristics for each of the four possibilities, together with the relevant hockey stick diagram.

A long call will, if exercised, produce a long FX position (buy the designated currency, value spot) at the strike rate. An exercised long put will produce a short FX position (sell the designated currency, value spot). This should be fairly evident by now and is represented under the buy (long) option column in the table.

The sell (short) option column represents the opposite viewpoint whereby the call exercise will result in a short FX position by the option

16 Option time value is explained in detail in Chapter 6.

	Buy (long) option (pay premium)		Sell (short) option (receive premium)	
Call	Right to *buy FX*		May have to *sell FX*	
Put	Right to *sell FX*		May have to *buy FX*	

3.8 Underlying position.

writer supplying (i.e. selling) the designated currency through a spot transaction at the strike rate. The exercise of a short put will result in a long FX position by the option writer receiving (i.e. buying) the designated currency through a spot transaction at the strike rate.

A long position in FX will gain if the FX rate goes up and it can be seen that both the long call and short put will profit in this circumstance. Likewise, a short FX position will gain on a declining FX rate and both the long put and short call have this characteristic.

Thus, there are two ways of creating a long (or short) FX position through options. The big difference is, of course, the premium cash flow and the certainty of exercise on maturity. The buyer can always take delivery, if he/she wishes, but the option seller does not have this guarantee. It is for this reason that neither of the two possible underlying FX positions created through options have the symmetrical FX profile shown in Fig. 3.1 (long FX) and Fig. 3.2 (short FX).

However, it is possible to create a synthetic FX position by combining an option call and put, as explained in Chapter 5.

CHAPTER

4

The market-place

FX options are traded in two distinct markets: over the counter and exchange listed. There follows an analysis of each.

Over the counter (OTC)

The largest, by far, is the OTC market, which comprises banks, American security houses and corporations. Over the counter means nothing more than 'direct between counterparties' although the phrase is never applied to the FX market which operates in a similar fashion - even the tourist gets foreign currency over the counter! The term 'interbank' would be better applied to the OTC options market although it is rarely cited.

Location

There is no single market-place or building that houses the OTC market as all transactions are conducted over the telephone, the Reuters dealing system (a telecommunications device used extensively in foreign exchange,

principally by banks) or through OTC brokers. Telex is rarely used these days except as a form of written confirmation for deals already concluded. The market operates continuously between counterparties all over the world and is therefore open 24 hours a day. The only exception is at weekends where liquidity drops to near zero although, in theory, banks in the Middle East may provide some market support if this area develops in the future.

Products

The OTC market offers a wide range of option products that are generally classified as being either 'plain vanilla' - European and American-style options or exotic. An exotic can be any other form of option that has an additional feature (e.g. a barrier) or where the option value on maturity is specified differently (e.g. by averaging spot or by restricting payoff). Chapter 11 lists all of the popular exotic options.

Some banks offer option products on exotic *currencies* (such as Thai bhats, Mexican pesos, etc) and these are sometimes referred to as exotic options but this is a misnomer - the option is merely a plain vanilla on an exotic currency.

Market access and credit

Generally speaking, access to the OTC market has to be through a bank, very similar to the underlying FX market. Option transactions in the OTC market are bi-lateral agreements meaning that each deal is an independent legal contract between one bank and another, or between a bank and its customer. Such contracts are 'unsecured' in the sense that default by one party may result in potential loss to the other. This means that every bank has to have a 'credit line' for every counterparty to record the possibility of loss, in the same way as an unsecured overdraft, or loan.

For bank customers, such as corporations, there is a solution to the counterparty credit problem (assuming credit is a problem in the first place) in that options sold (i.e. a bank sells to his customer) do not carry credit risk once the premium has been received (the premium being the maximum profit to the option writer) and this can be achieved by debit direct to the customer's account, at the bank. The remaining possible settlement risk[17] (the

17 Settlement risk exists on the day that an exchange of currencies takes place. For example, a bank may have to pay the sold currency, say JPY in Tokyo, before having received confirmation of the bought currency, USD later in the day, in New York.

physical exchange of currencies if the option is exercised by the buyer) can be mitigated by the same route - the payment of the sold currency (debit) and receipt of the bought currency (credit) can be processed by the same bank. Under such arrangements, there is no counterparty credit risk.

Options bought by banks (e.g. sold by a corporate customer) carry full credit risk, even if one is able to negate settlement risk.

Creditworthiness will therefore determine the accessibility to the market for both banks (directly) and corporate companies (through their bank, or series of banks). Chapter 15 addresses the issue of counterparty credit risk.

Brokers

The brokers in the OTC market are intermediaries who act to bring counterparties together but have no part in the transaction itself (similar to an estate agent). A fee is levied on both parties by the broker for such deals; hence trades concluded on a direct basis are commission free (e.g. there are no fees when a corporate deals with its bank). This follows a similar practice in the FX market. Many brokers quote volatility prices through Reuters and Telerate (information vendors specialising in live transmission of financial data to monitor screens world-wide) for information purposes.

The last few years have seen OTC brokers branch out into offering services in exotic options - previously the exclusive domain of the banks and their customers. The broking of exotic options has helped increase the liquidity of this product in the recent past.

OTC brokers are exclusively used by banks. Corporate use of brokers has never developed for two reasons: firstly, banks do not like paying broking fees to deal with their own customers and have, in the past, put pressure on the broking houses not to show corporate names in the market and, secondly, corporate companies do not like paying transaction fees (brokerage), even though the value of a better price might outweigh such.

Regulation

Trading between the banks in the OTC market is conducted in a very professional and efficient manner, given that there is no single regulatory body covering the whole market, globally. Supervision of banks is normally the responsibility of the central bank (for example, the Federal Reserve Bank in the USA) except in the UK where the FSA (Financial Services Authority) gained this responsibility from the Bank of England back in June 1998.

World-wide, around 20 central banks have drawn up codes of conduct for market participants. In the UK, the FSA's London Code of Conduct sets out the general standards and controls required covering foreign exchange (including options), deposits, bullion and other products and gives a statement of best practice for dealing principals and procedures. The Association of Corporate Treasurers in the UK commends this code to its members, which also deals as principal in the markets, as best practice, to which they, too, should adhere. A copy of the London Code of Conduct can be downloaded from the FSA's website, see Appendix II for details.

Aside from central bank supervision, FX and option dealers abide by a code of conduct issued by the Committee for Professionalism of the ACI (Association Cambiste Internationale - the Financial Markets Association) - the international trade association that encompasses Foreign Exchange markets.

Documentation

Standard terms and conditions for OTC options, together with trading practices' guidelines, are encompassed under ICOM (international currency options market) terms and conditions or under ISDA (International Swaps and Derivatives Association Inc) although market participants are free to trade under their own terms, if they so wish. ICOM and ISDA are discussed in Chapter 14, Documentation.

Contract specifications

It can be seen that the OTC market is not governed by the rules of an exchange and can therefore quote options in any currency pair, style, amount, date, strike, premium or rate quotation, within reason. While professional dealing is conducted in volatility terms, most banks will quote prices in any of the four ways possible: as a percentage of the first currency, as a percentage of the second currency, as the first currency in terms of the second or as the second currency in terms of the first (pricing terms are explained in detail in Chapter 6).

Transaction size and volumes

The volumes transacted daily in the OTC markets are, at the time of writing, around 100 billion US dollars, with individual trades averaging around USD 25-35 million. The minimum varies with most banks willing to deal small

amounts of, say, USD 500 000 with their own customers but keeping quotes to other banks at a minimum of USD 5-20 million, depending on the currency pair and the particular bank involved. Many of the larger active institutions have an absolute minimum of USD 20 million for interbank dealing.

Banks will accommodate any reasonable amount with corporate clients, although smaller amounts tend to attract wider dealing spreads as the banks attempt to recover processing costs, which can be as much as 500% of any potential profit margin on such deals.

Specialisation

Apart from the size of transaction, the number of market participants is at such a level that many specialise in different segments of the market. For example, Japanese banks are very active in currencies against the yen but generally less so in, say GBP/USD. Certain banks have reputations for quoting the more 'minor' currencies such as the Swedish krona whilst others welcome the smaller trades of USD 5-10 million in the popular currencies. The problem is knowing who does what, as there is no guide available other than contacting an experienced trader at one of the banks active in the market. It would be pointless to try to publish a list as the market is constantly evolving and traders tend to move between banks frequently, changing the trading emphasis of the institution with which they are employed.

Summary

The OTC, or interbank, market offers the ultimate flexibility in terms of contract and product diversification without any fees or margins. Against this, one needs a credit facility with a bank in order to enter into a transaction unless specific arrangements are made to negate such (i.e. for corporate customers). For banks, the OTC market is restricted to institutions that have a credit standing sufficient to enable transactions to take place, i.e. each participant needs a credit line for each individual counterpart that it expects to encounter. So, for most parties, access is through a bank, usually one where a relationship already exists.

Professional transactions take place in terms of traded volatility. Whilst there are many sources of volatility rates - Reuters, Telerate, Bloomberg and the like - they are not (yet) published in the financial press and, even if they were, one would require a pricing system and the knowledge to convert to premiums for value comparison. This is where this book will be of assistance.

Exchange listed options

Options are traded on various exchanges around the world and these exchange listed options form the second of the two markets.

Location

The principal exchanges for currency options are:

Exchange	Product
The Philadelphia Stock Exchange (PHLX)	Option on foreign exchange
The Chicago Mercantile Exchange (CME)	Option on currency future
FINEX – a division of the New York Cotton Exchange (NYCE)	Option on currency future

There are various other exchanges trading in miscellaneous (usually local) currencies but trading volumes tend to be very small.

All exchanges have a physical location. There are different types of trading methods employed, depending on the particular exchange but most are based on 'open outcry' or 'pit trading'[18] as the core principle. In order to compete with the 24-hour OTC market and provide a service for customers outside the USA time zones, the exchanges have had to provide methods of trading outside the regular opening hours. Such methods include extended hours (PHLX), alliances with other exchanges (CME and FINEX) and electronic trading (CME).

Trading practices

Customer orders are transmitted with hand signals and vocal expression to the crowd in the pit by open outcry. This form of trading has been the cornerstone of exchanges for decades and is an impressive sight when there is great activity in the pit. This form of trading is very different from the 'unseen' OTC market.

Until 1992, all prices were quoted in US cents with premiums payable in that currency, but cross-currency options have since been introduced

18 Open outcry or pit trading is that method whereby transactions may only take place in a specified area on the floor of the exchange by market participants shouting and/or using hand signals to display their bids and offers for a particular contract.

allowing for premium payment in currencies other than US dollars. At the time this was considered a breakthrough for both the PHLX and the CME exchanges, but cross rate options have not been a success, resulting in delisting of some contracts.

Because prices are quoted in terms of value, rather than volatility, an option's 'implied volatility' has to be calculated in order to be compared with the OTC market (implied volatility is dealt with in detail in Chapter 5). This is a major drawback for professional OTC traders who might otherwise make more use of the exchanges. Some exchanges provide implied volatility prices through information carriers, e.g. Reuters, or web sites on the Internet, but such rates are for information purposes and cannot be dealt upon.

The PHLX lists currency options based on physical delivery of the currencies if exercise of the option takes place - as on the OTC market. The CME and FINEX are somewhat different in that exercise of the currency option results in a 'currency future' on that exchange.

A currency future is similar to a FX forward contract except that the future can only be traded for a specific delivery date, usually the third Wednesday of March, June, September or December (at the CME and FINEX). Options are, however, traded for maturities at other time periods (see following section on products below), but exercise will always result in a future contract for the next future expiry date. Hence, exercise of an option maturing in October will result in a December future, as will the exercise of both November and December options. Exercise of the March option would result in a March future, etc.

Products

Exchanges only trade plain vanilla options and only on specified currencies. However, the PHLX introduced its united currency options market (UCOM) in November 1994 which goes a long way to replicating the flexibility of the OTC contract - users are allowed to specify strike and maturity dates across a matrix of currency pairs for European-style options. At the time of writing, UCOM volumes are expanding to the point of exceeding the standardised options that are declining. UCOM may well branch into exotic options sometime in the future.

Just before the introduction of UCOM, the PHLX added 3D (dollar denominated delivery) FX options to its list of products in September 1994. This is a cash settled option (in USD) that matures each Monday, the idea being to offer a short date option to compete with the OTC market where large volumes are seen in options with maturities of less than one week.

Contract specifications

With the exception of the UCOM market in PHLX, all contracts have fixed maturity dates, strikes, currency amounts, styles, premium quotations, etc, on a limited number of currency pairs. Generally, strikes are quoted in reciprocal terms (except FINEX), also called American terms though they have nothing to do with the style of option exercise. UCOM on PHLX allows flexibility in terms of strike quotation and maturity date but is restricted to a specified list of currencies (although all cross rates within the list are traded) and to multiples of contract amounts (about $50 000).

Contact addresses and website locations for PHLX, CME and FINEX contract specifications are listed in Appendix III. Contracts are continually added and delisted on exchanges so readers interested in using the exchanges should refer to the relevant exchange for up to date information.

Brokers

The brokers in exchange markets differ from those in OTC in that they play a very important role in the processing of the transaction. Payments of all kinds - margins, premiums and currencies - are paid to or from the broker. Therefore it is a requirement to have an account with a broker who has a seat on the exchange in order to use such markets. When an order is executed, the trade has to be cleared by a broker acting as a clearing member (this may, or may not, be the same broker who executes the trade).

Commissions are charged on a per contract basis by the broker but there are usually other fees charged by the exchange that are collected through the broker such as exercise and assignment fees. Exchange fees are set but brokers' commissions are negotiable with strong competition amongst the members of the exchange. In effect, each exchange guarantees the performance of its members so the credit risk is normally assessed as being the exchange's rather than the broker's.

Regulation

All trading is under exchange rules and the rules of the relative clearing corporation. Some of the practices may seem peculiar to OTC traders but most are based on rules that stipulate that all trading must be conducted in the pit (even if a broker has a buy and sell order of equal proportions). The US exchanges are regulated by other bodies such as the Commodity and Futures Trading Commission (CFTC) for futures exchanges (e.g. CME) and the Securities and Exchanges Commission (SEC) for securities exchanges (e.g. PHLX).

Margins

All exchanges use the margin system to ensure performance of the members and the members use the same system for their clients. Customers are required to pay a percentage of the contract value to their broker (for deposit with the exchange). This payment is called the 'initial' margin and covers the party on the other side of the contract against default. Since markets move and the value of the contract can change, further amounts may be paid as 'variation' margin in order to keep the default cover in place. The system works both ways in that excess margin is paid back to the client for positions that have gained in value. The variation margin is calculated by reference to the daily closing price of the contract, sometimes referred to as 'marking to market'.

Margins on option contracts can be made in cash, treasury bills and certain other securities, but futures contracts are generally margined in cash only.

For options purchased, the premium is the margin (as that amount is the maximum loss to the contract holder) and no further payments are necessary. For option sales, full initial and variation margins are required.

The margin systems and requirements employed differ between exchanges. Full details may be obtained by contacting the relevant exchange using the address provided in Appendix III, Exchange contract specifications.

Transaction size and volume

The exchanges publish daily details of the number of contracts traded, together with 'open interest' figures for each of the currencies traded. At the time of writing, daily currency option volumes are around a few billion (USD) for the three exchanges mentioned in this chapter, a small fraction of the estimated OTC volume.

Transaction size can, of course, be as low as one contract (which varies between about USD 80000–200000 depending on currency and the exchange concerned) or in the thousands. The average might be around USD 8–10 million.

Specialisation

The US exchanges specialise in options against the USD with liquidity concentrated in the near month maturities, usually at strikes close to spot. The small contract size and the margining system allow individuals to trade, resulting – in the case of the CME – in a great deal of speculative business

(the so-called Chicago dentist). Speculation is generally not deemed to be a bad thing as it adds to the liquidity of the market.

The PHLX, on the other hand, tends to be used more for hedging purposes as indicated by the level of open interest versus trading volumes. FINEX, with larger contract sizes, tends to be used by some banks and other professional traders.

Electronic trading: Globex2

In June 1992, the CME introduced FX options and futures on Globex - an electronic dealing system developed jointly with Reuters. This system allowed for after-hours trading in certain CME contracts (such as some of its options on currency futures).

Globex was a bold move on the part of the CME who have proliferated for years on the advantages of the open outcry, pit trading and the success of such ideology. The only alternative approach would be to extend the trading hours on the exchange, and this is the route taken by the competing exchange for currency options - the PHLX. Globex was not used to any great extent for currency options and ceased in April 1998 when the contractual agreement with Reuters ended.

Globex2 is now in operation offering electronic trading in several products, including options on selected currency futures, during hours when the exchange in Chicago is closed. For London, the published hours of operation are 8.30 pm to 1.05 pm (the next day). As with trading on any exchange, access to Globex2 can only be made through a registered broker - you cannot have direct entry.

Summary

The exchanges will appeal to those who are familiar with equities or futures as arenas for investing, hedging or speculating - the basis of dealing currencies has been offered in the same context as the other products. This is the reason why the first USA exchanges always quoted FX rates in USD, e.g. one IBM share costs USD 88.5; one pork belly future contract costs USD 40; one EUR costs USD 0.66, etc. Closing prices are published in the financial press daily alongside the other listed securities.

The exchanges are open to all, albeit through a broker, and offer very competitive, open pricing for large or small amounts, giving the small player access to interbank rates. Against this feature one has to evaluate the costs of brokers' commissions, exchange fees and margin requirements.

The pit method of trading using open outcry has been very successful in the past but one must question the validity of such methods in the future,

given the efficiency of electronic trading systems now available and the widening world of the Internet. In the past, many exchanges world-wide have moved from traditional methods to electronic forms - even the mighty CME has Globex2, albeit as a secondary measure for after-hours trading.

Comparison (OTC versus exchange listed contracts)

Table 4.1 gives a comparison of OTC and exchange listed contracts.

In Chapter 2, it was stated that FX rates might be expressed in two ways: the first in terms of the second, or the second in terms of the first, for example:

USD	EUR	1.7500
EUR	USD	0.5714

For a given currency pair, the international FX market generally quotes that rate that is above par, that is, above the number 1. So, in the USD/CHF currency pair, this is the USD/CHF expression of 1.5500. Unfortunately, there are exceptions to this rule, such as AUD/USD where the rate was originally above par but has subsequently dropped below; the FX market does not switch quoting terms in these cases. In the more liquid exchange markets, such as the CME, rates are quoted in USD per currency unit so some of the largest traded spot currencies, such as JPY and CHF (Swiss francs), are in unfamiliar, reciprocal terms. The exceptions are GBP, AUD, NZD and, now, EUR.

To change from one expression to the other, reciprocate: e.g. 1/1.55 = 0.6452; 0.6452/1 = 1.55.

Advantages and disadvantages

The reciprocal aspect of the listed market strikes and futures quotation does not help the corporate who normally expresses the rate of exchange in the same manner as the FX market, making the selection of strike, etc, less convenient.

Prices and transaction volumes from the exchanges are widely available from the various information carriers and are published daily in the financial press. This makes it very easy to compare option prices for value, whereas the OTC market does not produce such information - the customer has to ask for a price from a bank.

Table 4.1 OTC versus exchange.

		Exchange listed	
Feature	**OTC**	**PHLX, CME, FINEX**	**Exceptions**
Market access	Through a bank	Through a broker	
Currency	Any pair that has free spot and forward market	Limited to those listed	
Strike	Any, within reason	Limited, fixed strikes	PHLX UCOM allows for any strike
Rate quotation	As per FX market, but either available	Inverse to FX market (except EUR, GBP, AUD & NZD)	FINEX as per FX market, PHLX UCOM allows for either
Price quotation	Any, as required	USD terms only	FINEX, PHLX UCOM cross rates
Style	European by default. American available	American[19]	American and European on PHLX standardised
Exotics?	All	None	
Initial margin	None	Yes, but on sales only	
Variation margin	None	Yes, but on sales only	
Formalities required	Counterparty needs credit line in place to transact	Broker agreement	
Credit risk	You are at risk of your counterparty (your bank) defaulting	Considered to be zero – exchange guarantees every transaction	
Broker fees	None on bank/ customer, or other direct transactions	Yes, mandatory	
Other commissions	None	Assignment and exchange fees	

The margin system used by all exchanges is usually considered to be a disadvantage as it employs capital and additional, sometimes daily, variation margin calls which can be administratively time consuming. However, the system does ensure that everybody has access to the market, therefore suiting individuals and smaller companies who may not be granted the credit facilities at banks for the OTC market. A few OTC participants do offer margin facilities for OTC options to cover the credit risk.

The OTC market offers options in almost any currency pair including

19 The CME and FINEX options on currency futures may be exercised at any time so are deemed to be American style. However, such exercise can only produce a contract to exchange currencies at a future date (the expiry date).

'crosses' (where neither currency is the USD) and exotic currencies (such as Thai bahts), whereas the exchanges are only now responding to the demand in this area. Option maturities from one day to five years or longer are available in the OTC market, whereas listed options are restricted to set days in certain months for a few months each year.

The fixed aspect of the exchange markets means that the liquidity tends to be concentrated in strikes at the money in the near months. Whilst this gives tight spreads (the difference between the buying and selling price) for such contracts, the far months and other strikes tend to have low liquidity and wide spreads. The flexibility of the OTC market ensures a fair spread of liquidity through both strikes and dates.

Dealing on the exchanges involves contract fees, exchange fees and assignment fees (for options exercised), whereas there are no commissions whatsoever in OTC.

Conclusion

From the corporate perspective, the OTC market offers distinct advantages over the exchange-listed contracts in terms of hedging efficiency, convenience and cost. Access should be no problem as every corporate will have existing banking relationships and competition between banks for corporate business will ensure excellent value. Use of the exchanges by corporate companies is usually on the basis of counterparty credit considerations (the possibility of bank default) or for price visibility reasons (closing prices are published daily).

The world of foreign exchange - nearly 1.5 trillion dollars daily - is, and always has been, an OTC market dominated by banks and other large financial institutions. It follows that the FX option will be included in this realm. Many exchanges, such as LIFFE in London, have attempted to gain access to this vast market but have been unsuccessful in their attempts. Strange as it may seem, London - the largest market in the world for foreign exchange - does not have a single exchange product in FX or FX derivatives. One must go to the USA to find such markets where the total volume in FX options might reach one per cent of that traded OTC - very small by comparison.

The exchanges are more successful in other financial commodities, especially interest rate futures and options where, in certain contracts, they lead the equivalent OTC markets. For the corporate looking to hedge interest rate risk, the exchanges can offer very liquid markets with strong competition between different centres (e.g. London and Frankfurt).

CHAPTER

5

Put–call parity

The FX option is a derivative of foreign exchange and as such there is a direct relationship between the call, the put and the underlying FX contract known as put-call parity - see Fig. 5.1 - (it is easier to pronounce than call-put parity!). So, a long call, together with a short put, gives a synthetic long FX position. We can prove this by looking at the positions graphically, as shown in Fig. 5.2 and Fig. 5.3.

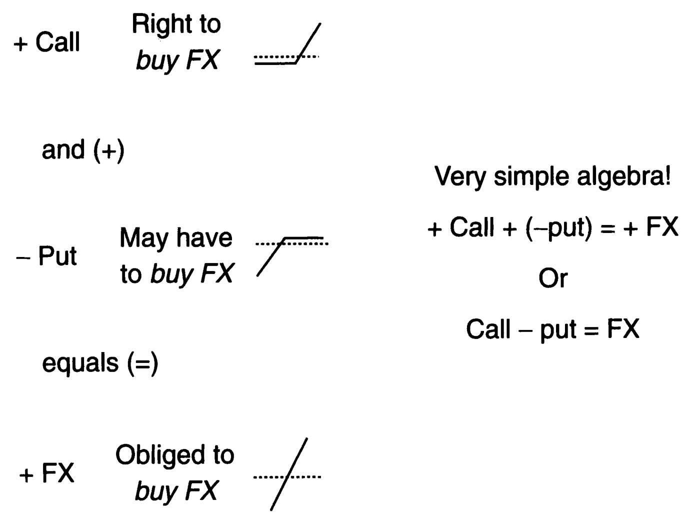
Synthetic positions

The long FX position shown in Fig. 5.3, being produced by the combination of two options (rather than the straight purchase of GBP/sale of USD) is known as a *synthetic* (long) FX position.

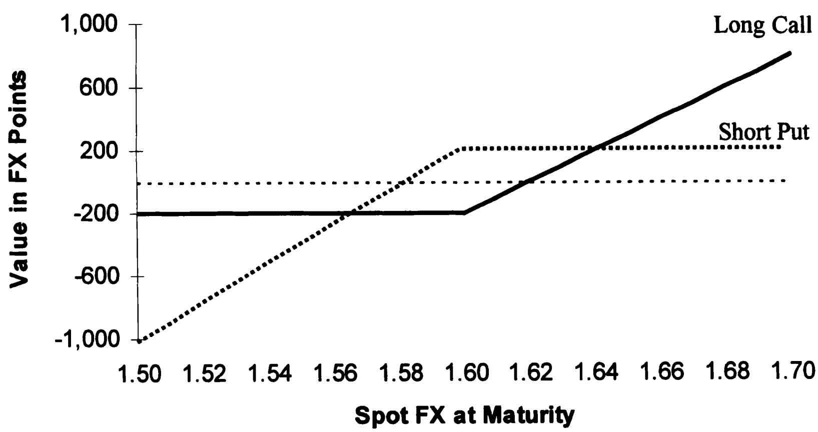
If C = call, P = put and FX = foreign exchange, we have two simple formulas for the synthetic FX positions:

Long FX: $C - P = FX$
Short FX: $-C + P = -FX$

Using the above respective formulas and simple algebra, we can get:

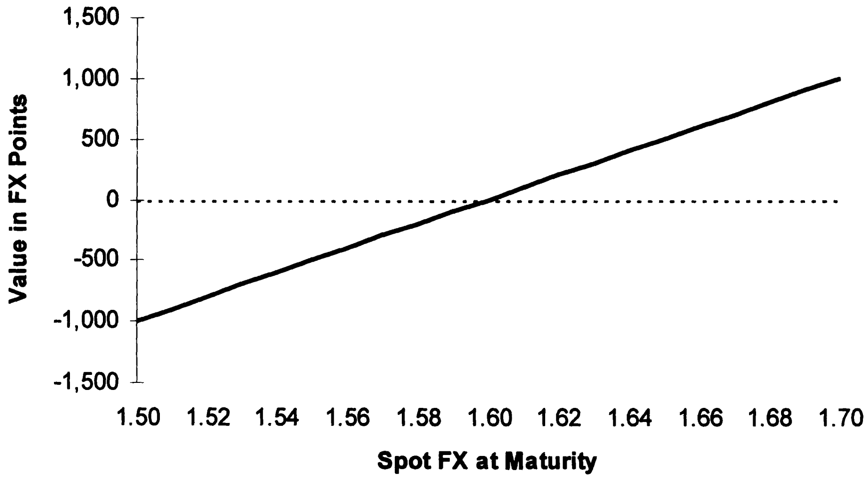


5.1 A bought (long) call and sold (short) put will equal a (long) forward FX position, provided the strikes, amounts and maturity dates are the same.



5.2 Long GBP call ***and*** short GBP put - strikes 1.60; premium 2 cents for each option. Maturity dates for both options are the same with the two positions ***shown individually***.

The long call, shown by the solid line, has limited loss of the premium of 200 points with unlimited profit potential. The short put, shown by the broken line, has a limited profit of the premium received of 200 points but has unlimited loss potential.



5.3 Long GBP call *and* short GBP put - strikes 1.60; premium 2 cents for each option. Maturity dates for both options are the same with the two positions *shown combined.*

The two premiums of paid 200 and received 200 can be netted to zero leaving the FX position of Fig. 3.1 long FX position - long GBP/short USD FX at 1.60.

1: C – P – FX = 0
2: –C + P + FX = 0

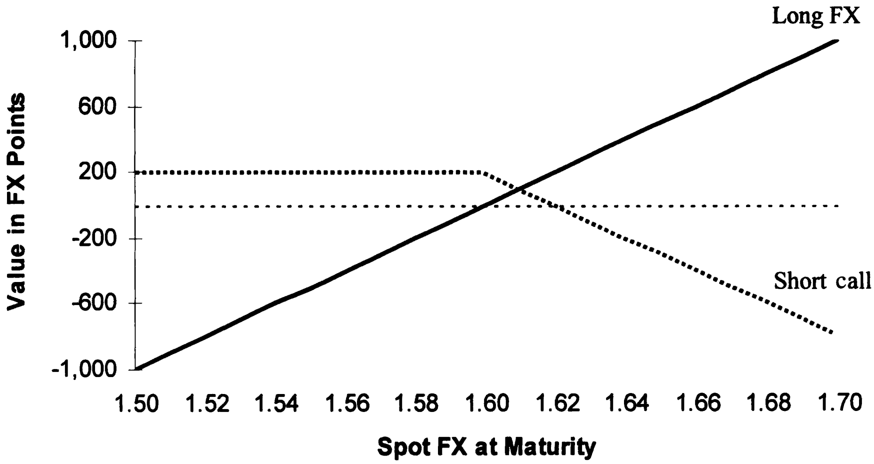
Where 0 (zero) represents no position,[20] movement of the FX rate and/or the option premiums is offset exactly, in all cases. Point 2 is known as a conversion with point 1 being a reverse conversion, but the market generally refers to either as simply a conversion. The option trader uses conversions to achieve risk-free positions and to arbitrage between options and FX markets.

We can also use the formulas to achieve synthetic option positions as follows:

Long call	P + FX = C
Short call	–P – FX = –C
Long put	C – FX = P
Short put	–C + FX = –P

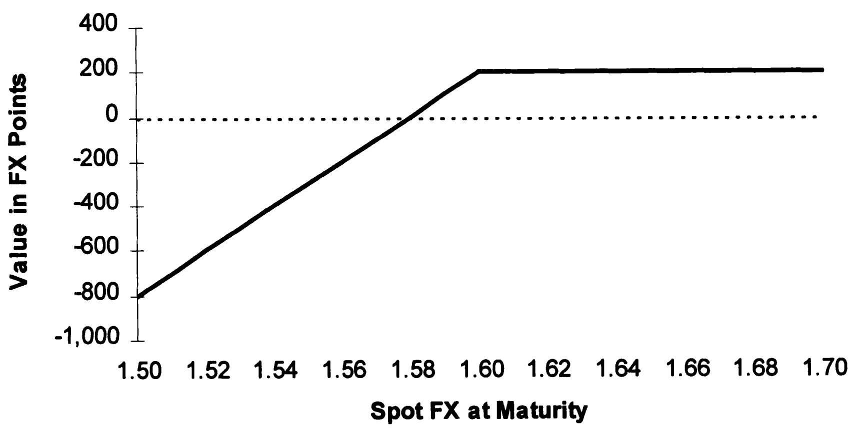
To demonstrate a synthetic option position we can now take another look at the example under short options in the last chapter where a US company

20 Strictly speaking there are three positions (long call, short put and short FX) but the combined effect is the same as having no position or, more accurately, a zero risk position.



5.4 Long GBP (short USD) FX at 1.60 and short one-month GBP call (USD put), strike 1.60, premium 200 points, ***shown individually.***

The short call, represented by the broken line, has a limited profit of 200 points but unlimited losses on an increase in GBP/USD and is offset exactly by the underlying long FX position at all rates above 1.60.



5.5 Long GBP (short USD) FX at 1.60 and short one-month GBP call (USD put), strike 1.60, premium 200 points, ***shown combined.***

The profit from the long FX position on GBP/USD rates above 1.60 is offset by the short call leaving the premium of 200 points as the only reward. At rates below 1.60, the call expires worthless but the FX position loses value. Net result is same risk position as a short put.

has balances in GBP and writes a GBP call (USD put) option against those balances to gain the premium income - yield enhancement. The company's position is long FX (GBP in bank account) and short the GBP call which is a short GBP put (USD call) - shown graphically in Figs 5.4 and 5.5.

The reader will recall that, in this example, the company sold a one-month sterling call against balances held in an account with non-specific maturity. In this case, the synthetic put only holds as such if the treasurer commits the balances against the written call which, of course, he does as part of the strategy. However, a true synthetic put would have the FX committed to mature on the potential delivery date of the option (usually by an FX swap) so that the pricing of the strategy could be determined, i.e. is the synthetic version better than the straight written put?

Put-call parity is fundamental to understanding options. The fact that it is easy to change a call into a put, or vice versa, by simply dealing in the underlying means that an options dealer is never really concerned about whether options are calls or puts - only whether they are long or short of options. Examples of this will be shown in later chapters.

Put–call parity: working example

Examples of put-call parity at work can be seen in many markets but probably the best example is that in equities where the strategy of a covered call write is quite common. This strategy is basically the same as that used in the example above where the US company sold a GBP call against sterling balances held in an account. The equity covered call write strategy goes something like this:

1. *Buy shares at, say 100, to yield dividend of 2% pa.*
2. *Sell call, strike of 120 (out of the money) on the shares for premium of 15.*

From the above, all is apparently good news:

(a) If the shares go up and beyond 120, you will be happy to sell at 120 (through the call exercise against you) because that is a profit of 20 *plus* you also get the option premium of 15 = total of 35 profit.

(b) If the shares go up but do not reach 120 you will profit by the difference of share price minus 100; *plus* the option premium of 15 as the call will expire out of the money, e.g. at 105, share profit = 5, plus option premium of 15 gives total of 20.

(c) If the shares stay at the same price, or go down, you will always be better off (by the option premium of 15) than if you were holding the shares alone. For example, at 80, the investor will make a loss of 20 on the share purchase but will gain 15 back from the call option premium giving a net result of 5 loss.

In this example, it can be seen that *selling* an option is more conservative than just holding the shares and many a broker will tell you that you should *never* sell options alone as this is a very risky strategy because you have unlimited loss on exercise. However, if we look a little closer at what the investor has done, we find:

1. *Long shares (the underlying) at 100.*
2. *Short call on the shares at 120 (out of the money).*

Though put-call parity this is a synthetic *short put*, i.e. + shares – call = –*put*

So the cover call write is, in fact, nothing more than a short put. The investor has exactly the same risk parameters on the short put and this can be demonstrated as follows:

Sale of put at 120 = premium of 35, being intrinsic value (in the money amount) of 20 plus the time value of 15. (For a further explanation of pricing, see Chapter 5.)

(d) If share price goes up, the investor will profit up to a maximum of 35 at, or above, 120 where the put will expire worthless. This profit is the same as in (a) above.

If share price goes up but not beyond 120, put will be exercised by holder for value equal to 120 – share price, assuming cash settlement on the option,[21] e.g. at 105, value is 120 – 105 = 15 or –15 for the investor having sold the put option. Net result for the investor is +35 on premium, –15 on put exercise = +20 or the same as in (b) above.

If share price stays the same or goes down, then put will be exercised for value of strike less share price, which will be an increasing loss for the investor. However, the put premium receipt of 35 can be offset against such a loss. For example, at share price of 80, put value is 120 – 80 or 40, but less 35 for the premium gives a small net loss of 5 to the investor - the same as in (c) above.

Looking at the above example, it can be seen that there is little point in doing two transactions (buy shares and sell call) when you can do one (sell put) except from the broker's point of view! But what about the statement that selling options without the underlying security is 'dangerous'? Clearly, there is no difference in risk so the answer lies in the *perception* of the investor. If the share purchase is treated as a separate decision with full knowledge

21 Cash settlement is a process whereby exercise of the option results in a payment (in cash) of the difference between strike and the underlying rate, rather than delivery of the actual underlying principal amount (in this example, the shares).

that the investor could lose all his money should the stock go to zero, then selling options against the shares is a conservative action. Selling options for premium receipt alone and without the knowledge of unlimited loss is, indeed, dangerous. On the other hand, how many investors employing the covered call write strategy realise they have nothing more than a short put?

Other synthetics

There are numerous possible combinations of calls, puts and the underlying FX with different strikes, amounts and maturity dates. In as much as the price of an option reflects rates from different markets such as FX and interest rates, it is possible to recreate each component synthetically by using options in conjunction with other constituent parts. We have already seen that put–call parity can produce synthetic options or FX positions, but it is also possible to produce synthetic ***interest rate positions*** (e.g. a loan) through options combined with spot/forward FX.

Consider the following example:

Buy	Three-month GBP 10 million put (USD call), strike GBP/USD 1.50 Premium: 62.74 points Cash premium paid: USD 62 740 (GBP 10 million × 0.006274)
Sell	Three-month GBP 10 million call (USD put), strike GBP/USD 1.50 Premium: 1783.52 points Cash premium received: USD 980 850 (GBP 10 million × 0.098085)
Buy	Three-month GBP 10 million (sell EUR) FX forward at 2.7434

Current market rates:
Spot GBP/USD 1.6043; three-month forward swap[22] 118 points
USD interest rate: 3.00%

The position is: long put, short call, long FX forward, which through put–call parity is a risk free position, i.e. put – call + FX = 0. Whatever happens to the spot FX rate is irrelevant as, in three months' time, the strategy sells GBP (either through exercising the long put or by being exercised on the short call) and at the same time buys GBP through the FX forward contract. Note the premium cash flow:

22 Forward FX rates are quoted in FX points as premium or discount from spot. They are calculated from the current spot rate and the fixed interest rates for each of the currencies within a given pair.

Bought GBP put (USD call)	USD 62 740	Debit
Sold GBP call (USD put)	USD 980 850	Credit
Net premium receipt	USD 918 110	Credit

This net premium is received value spot, two business days after the transaction date.

Now look at the position on maturity, in three months' time:

	GBP	USD
Option exercise	−10 000 000.00	+15 000 000
FX forward	+10 000 000.00	−15 925 000
Total cash flow	Zero	− 925 000

So, the premium receipt is USD 918 110 value spot against net outflow after three months of USD 925 000 representing a cost of USD 6800, or 3.00% per annum over three months - the original USD interest rate for that term. The strategy is therefore a synthetic loan at that rate. This strategy was made possible by constructing the sold option as deep ITM, thereby ensuring a large premium receipt. Consequently, the bought option was very inexpensive as it was far OTM and only accounted for a tiny reduction in the net premium receipt. The purchase of the GBP put (USD call) was necessary, however, to ensure zero FX risk after the forward purchase of the GBP (sale of USD) in the FX market.

The use of synthetic loans through options may have advantages in some countries where there are restrictions on borrowing but where options and FX are unrestricted or where accounting standards differ between the products (accrual versus mark-to-market).

Interim values

All the aspects discussed so far have been on the basis of the option value at maturity for a given level of the spot FX rate at that time. Put-call parity holds true for all interim values of options providing the underlying FX rate is used - the forward rate for European style.

CHAPTER

6

Option pricing

Many books have been written on the subject of option pricing and all tend to delve deep into the mathematics of such; the author of this book has attempted to avoid this where possible, concentrating on the more practical issues. However, it would be impossible to write a book about options without mentioning the basis model, the Black-Scholes formula.

Black-Scholes

The acknowledged basis of modern option pricing theory is the often quoted Black-Scholes formula. Two theoreticians, Fisher Black and Myron Scholes, devised a formula in the early 1970s[23] in an attempt to produce a fair value for options on equities. Of course, FX options differ because there is no dividend and both currencies of the exchange carry interest rates that can be fixed until maturity. Hence, various adaptations to the original Black-Scholes formula have been made for use in FX options pricing. The best known of

23 Black, F and Scholes, M, 'The Pricing of Options and Corporate Liabilities', *Journal of Political Economy*, 1973.

these is the Garman-Kohlgagen[24] adaptation, which adequately allows for the two interest rates and the fact that a currency can trade at a premium or a discount forward, depending on the structure of the interest rate differential. For those more mathematically minded, here is the formula:

The theoretical value of a call is:

$$C = e^{-r_f T} S N[D] - X e^{-r_d T} N\left[D - \sigma\sqrt{T}\right]$$

where:

S = the spot price of the underlying currency
X = the exercise price (strike price)
T = the time to expiration (in years)
r_f = the riskless interest rate on the 'foreign' currency
r_d = the riskless interest rate on the 'domestic' currency

$$D = \frac{\ln(S/X) + (r_d - r_f + \sigma^2/2)T}{\sigma\sqrt{T}}$$

American-style options cause further problems in the pricing of options owing to the probability of early exercise. In 1979, Cox, Ross and Rubinstein[25] published a pricing model to take account of American-style options. By using the same basics as Black-Scholes, they adopted what is now known as the binomial method for pricing such options. This same binomial model is now used alongside the Garman-Kohlgagen version to price FX options.

Having reached the point 'FX options are priced according to a formula devised by Black-Scholes and adapted by Garman-Kohlgagen with modifications by Cox-Ross-Rubinstein (for American-style options)', it is time to take a look at the pricing factors and results, rather than the actual mathematics.

From the corporate's point of view, an understanding of how the price, or premium, of an option is arrived at is a very important aspect in comprehending the value of option use in managing FX risk.

Input factors for pricing

The following factors are required to price an FX option:

1 Call or put.
2 Currency pair.

24 Garman, Mark B and Kohlgagen, Steven W, 'Foreign Currency Option Values', *Journal of International Money and Finance*, December 1983.

25 Cox, John C, Ross, Stephen A, and Rubenstein, Mark, 'Option Pricing: A Simplified Approach', *Journal of Financial Economics*, November 1979.

3 Amount.
4 Maturity date and time.
5 Strike rate.
6 Style[26] (European or American).

7 Spot FX rate.
8 Interest rate for each currency or one currency rate plus 9 (below).
9 Forward swap. This can be calculated if both currency deposit rates are available in 8 (above).

10 Volatility for the currency pair.

The reader will notice that the pricing factors have been split into three groups. Each in the first group (1 to 6) is chosen, each in the second group (7 to 9) is given from the respective markets, but the third group has only one factor - volatility - which is peculiar to options. In fact, one could say that the FX options market revolves around volatility as it represents the anticipated volatility of the underlying FX rate - the forward FX rate for European-style options - over the life of the option.As it is the only unknown factor in the options price, the professional OTC market quotes in volatility rather than the actual price - the premium is easily calculated once volatility has been agreed between the counterparties.

Volatility

Volatility, expressed as the annualised percentage rate of change of a currency pair, is the key component of an option's time value and so the price of the option. For example, some currency pairs traditionally have low volatility, e.g. the Canadian dollar against the US dollar (owing to the very strong trade ties between Canada and the USA) and others such as those with official or unofficial pegs against the USD. On the other hand, the major trading currencies such as euros, yen and sterling usually have somewhat higher volatilities against the US dollar.

This leads us to a very simple and hopefully obvious rule:

> The higher the volatility, the higher the option premium.
> The lower the volatility, the lower the option premium.

26 American-style options are so rare in OTC markets that one can discount style from option pricing factors and always assume they are European (exercise only at maturity).

Change in volatility affects the option price by an increasing degree according to the maturity term of the option. An increase in volatility will have a lower effect (on increasing the premium) in short date maturities than in longer maturities.

Example:
Option price in \$ FX points for GBP call (USD put), strike 1.60 (at the money, spot) at maturity terms of 1 to 12 months, at 11.55% and 12.55% volatility.

Term (months)	**11.55%**	**12.55%**	**Difference**
1	200	221	21
2	262	287	25
3	316	346	30
4	348	385	37
5	379	419	40
6	408	452	44
7	429	476	48
8	445	495	50
9	467	520	53
10	482	538	56
11	496	554	58
12	511	571	60

In this example, the increase of 1% in traded volatility from 11.55% to 12.55% has the effect of increasing the one-month option price by 21 FX points, the 6 months by 44 points, and the 12 months by 60 points.

There are two types of volatility:

1 *Historical* - calculated from a series of FX rates in the past. (Known rate.)
2 *Traded (implied)* - the volatility factor in the option price, which is a forecast of the future FX rate volatility. (Unknown rate.)

So, high volatility equals high premium, low volatility gives low premium, but how can one calculate the future volatility of a currency pair? Unfortunately, without knowing the future, historical or current perspectives are the only guides to future performance.

Traded, or implied, volatility rates are not fixed - they move up and down like any other traded market - and are therefore, themselves, *volatile*. Professional participants in the options market bid and offer around the perceived volatility level for any given period, with supply and demand dictating the final level. Just like any liquid market, implied volatility rates can only rise to the point where sellers become evident and only fall to where buyers

enter the market. Thus traded volatility is an essential factor required to price an option.

If volatility is the key component and price can be calculated by combining the other factors using Black-Scholes, it follows that volatility can be computed if the option price is available. This is the *implied* volatility of the option and is frequently used in the case of exchange-listed markets where options are priced in US cents or other currency. After calculating the implied volatility, comparison is made to the OTC market to seek the better value option. It should be noted that traded volatility and implied volatility are one and the same - it is simply that the OTC market trades the volatility factor, whereas the exchanges do not (they trade the option in terms of the price).

There are two interpretations of the term *implied volatility*:

1 In the OTC market, volatility is the traded component of an option's premium and the price is implied (from the volatility rate).
2 On the exchanges, option prices are traded and the *volatility is implied* from the price.

In both markets, the volatility factor in an option's price is the *implied volatility* of the FX rate in the future.

Components of price

The resultant price of an option consists of two parts:

1 Intrinsic value (if any) - simple calculation, of strike ± underlying.
2 Time value - complex calculation, math model.

What we are saying here is that we need a particular type of mathematical model to calculate the time value component of an options price. The Black-Scholes formula adequately allows for all aspects of intrinsic and time value and other factors, such as funding costs on the premium (because it is paid up-front, i.e. at the start of the option).

Intrinsic value

Intrinsic value was defined in Chapter 2 as:

> The difference, if positive, between the strike price and the underlying FX rate

'Positive' refers to the point where exercise would result in a credit against the current FX rate, therefore options with zero, or negative difference, have no intrinsic value.

Example: GBP/USD option, strike 1.6000

	GBP call/USD put	GBP put/USD call
FX rate	Intrinsic value	
2.5500	0	0.0500 (500 points)
2.6000	0	0
2.6500	0.0500 (500 points)	0
2.7000	0.1000 (1000 points)	0
2.7500	0.1500 (1500 points)	0

Whilst the FX market tends to talk in points value as demonstrated above, many dealers use the term 'big figure' which is normally the second decimal place in the exchange rate so 500 points is also 5 big figures, 1000 points 10 big figures and so on.

It can be seen that the intrinsic value of an option is nothing but a simple calculation. It does have a significant effect on the price, especially if the option is deep in the money, i.e. the positive difference between strike and the FX rate is large.

> The price of an option can never be less than its intrinsic value.

Time value

Options that are OTM (with no intrinsic value) are priced on their time value alone. Options in the money will have intrinsic value added to their time value. Through put-call parity, it follows that call and put options with the same strike and maturity will have the same time value even though one (either the call or the put) will be ITM (unless both are ATM, in which case the call and put will be the same price).

Table 6.1 shows several examples of where time value is the same for call and put options at a given level of the underlying FX rate. Looking at the 1.61 FX level as an example, the GBP call price of 275 has an intrinsic value of 100 points (1 big figure) because exercise would result in buying GBP at the strike rate of 1.60 which is 100 points better than the current FX rate of 1.6100. Deducting this in the money amount from the price gives us the

Table 6.1 One-month GBP/USD 1.6000 option. (Prices that include intrinsic value are shown in bold.)

Current FX rate (forward)	GBP call/USD put		GBP put/USD call	
	Actual price	Time value	Actual price	Time value
1.5800	134	134	**334**	134
1.5900	174	174	**274**	174
1.6000	221	221	221	221
1.6100	**275**	175	175	175
1.6200	**336**	136	136	136

time value of 175 points which is the same as the put price at 1.6100 – the put, being out of the money, having time value alone.

Hence time value represents the *extra* cost associated with options versus a forward transaction.

Applying put–call parity to this example, we get:

Buy *call*	Pay premium	−275
Sell *put*	Receive premium	+175
Sell FX	Profit (1.61 – 1.60)	+100
Total	No position	0
	C – P – FX = 0	

Components of time value

The following are the main components of time value:

1. Days to maturity (i.e. time).
2. Volatility.
3. The distance of the strike from the underlying FX rate, irrespective of whether it is in or out of the money.
4. Interest rates (although interest rate differentials equate to the forward FX rate, i.e. it is included in 3 above).

The calculation of time value by the Black-Scholes model produces some unusual effects which will now be explained before we look at the inefficiencies of the model and how the market-place adjusts for them through the volatility factor.

Time value effects: non-linear nature

A three-month option will cost less than three times the cost of a one-month option. A one-year option will cost less than twice the six-month option. The reason for this is that time value decays at an accelerating rate towards maturity with little decay at the beginning of longer term options. Hence the buying of longer term options effectively gives better value for money than the purchase of shorter dates, although the premium is higher.

Example:
GBP call/USD put, strike GBP/USD 1.60.

Current rates: spot 1.60, fixed interest rates GBP 6%, USD 3% (all maturities).

Volatility 11.55% (all maturities).

Term (months)	Option price ($ points)
1	200
2	262
3	316
4	348
5	379
6	408
9	467
12	511

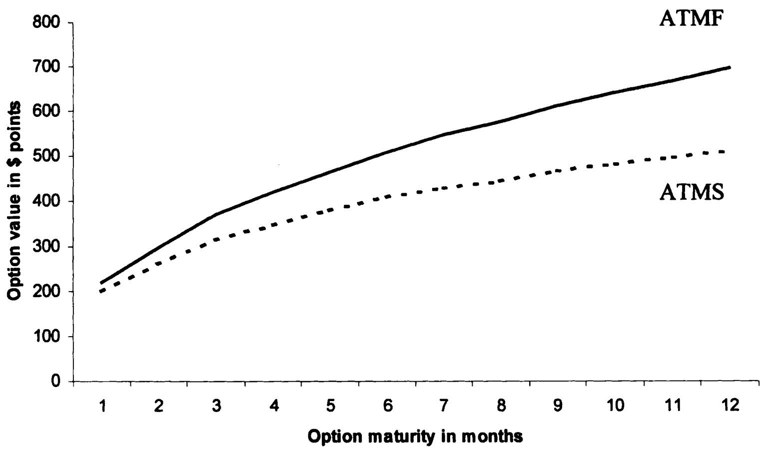
In this particular example, the strike rate for each of the periods has been set at GBP/USD 1.60 - the current spot rate. Such options are known as at the money, spot (ATMS). The 12-month option at 511 points would appear to offer excellent value compared to the 200 points for just one month. However, the 12-month option's price is based on the GBP/USD forward FX rate (being European style) for that period - about 550 points discount to the spot rate of 1.60 = 1.5450. At this rate (1.5450), the GBP 1.60 call (USD put) is out of the money, making this option much cheaper than would be the case (see point 3 of the list of the main components of time value).

A better comparison would be to set the strike as being at the money, forward (ATMF) as shown in Table 6.2.

The 12-month at the money, forward at 698 points is just over three times the one-month at 221, illustrating the non-linear effect of time value. Figure 6.1 shows the effect graphically comparing the at the money, spot with the at the money, forward strikes.

Table 6.2 Comparison of option vaue.

Term (months)	Strike 1.60 (ATMS) Option price ($ points)	Strike ATMF Option price $ points	Strike
1	200	221	1.5957
2	262	298	1.5922
3	316	370	1.5881
4	348	421	1.5840
5	379	465	1.5806
6	408	510	1.5768
9	467	613	1.5660
12	511	698	1.5552



6.1 Relative value - ATMS and ATMF GBP call (USD put) over different maturities from one month to one year.

For clarity, the option prices displayed in Table 6.2 and shown by graph in Fig. 6.1 have been calculated using a uniform volatility of 11.55% over all maturity terms from one month to one year. In practice, traded volatilities usually differ according to the maturity term, which is a practical factor not consistent with the Black-Scholes model. This aberration is explained later in this chapter.

There is an option strategy called a calendar spread which attempts to take advantage of the relative cheapness of longer term option maturities by purchasing a long-date option and selling the respective shorter dates in succession using the same strike.

Example of calendar spread:
Buy six-month GBP call (USD put), strike GBP/USD 1.60 for 408 points.

Sell three-month GBP call (USD put), strike GBP/USD 1.60 for 316 points.

When the short option matures (after three months):

Sell (remaining) three-month GBP call (USD put), strike GBP/USD 1.60 for 316 points.

Net result: profit of 224 (–408 + 316 + 316) points. During both three-month periods, the long option is covering the FX risk of the short options - the strikes are the same. As the FX risk in the sold option is always covered by the bought, the scenario has very limited risk parameters. Too easy? See below.

Time value effects: ATM versus OTM/ITM options

The time value of an option is built on the probability of its eventual exercise. It should be evident that the factors of the main components of time value (see page 53) all affect the probability of exercise (noting that factor 4, interest rates, determines the FX forward rate[27] - the underlying rate of European-style options).

At the money options (where the strike is at, or close to, the underlying FX rate) have the greatest *uncertainty* of eventual exercise because at this point there is a 50:50 probability of either the call or put being exercised at maturity. At any other point either the call or the put will be in the money (see the intrinsic value example on page 14) thereby creating more certainty. To put this another way, it is only when the option is ATM that the call and put prices can be the same, with *each* being neither in nor out of the money.

Table 6.3 shows option values at different *strike* levels for a GBP/USD, one-month option. The out of the money values - highlighted in bold - represent time value only (options with these strike rates do not have any intrinsic value) and one can see the highest time value is when the strike is to close to the underlying FX rate[28] of 1.6000 (spot at 1.6043 –43 on swap = forward of 1.6000).

Figure 6.2 is the graphic representation of the OTM values (only) from Table 6.3 and clearly shows the peak of time value at the 1.60, ATMF, level.

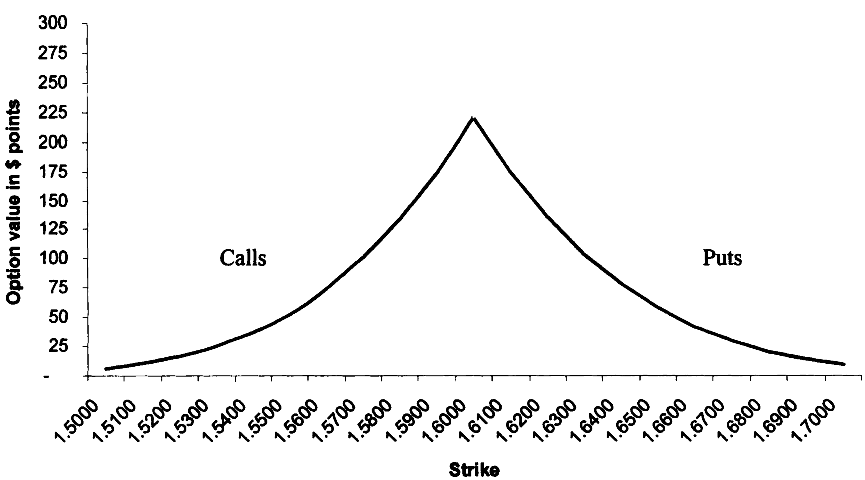
27 Reminder: the forward FX rate is calculated from the current spot rate and the interest rate of each currency within a pair.

28 Reminder: the underlying rate is the forward rate (not spot) for European-style options.

Table 6.3 Comparative value ($ point) of a series of GBP/USD options, each month maturity at different strikes.

Strike	Call	Put	
1.5000	1004	**7**	
1.5100	908	**11**	
1.5200	815	**17**	
1.5300	724	**25**	
1.5400	636	**37**	
1.5500	552	**53**	
1.5600	473	**75**	
1.5700	400	**101**	
1.5800	334	**134**	
1.5900	274	**174**	
1.6000	221	221	← At the money forward (ATMF)
1.6100	**176**	275	
1.6200	**137**	336	
1.6300	**105**	404	
1.6400	**79**	478	
1.6500	**58**	557	
1.6600	**42**	640	
1.6700	**30**	728	
1.6800	**21**	819	
1.6900	**14**	912	
1.7000	**10**	1007	

Market spot 1.6043, swap –43, uniform volatility 11.55% for all strikes.



6.2 Time value of options.

Comparative value (USD points) of a series of OTM GBP/USD options, each one-month maturity at different strikes. Market spot 1.6043; swap –43, uniform volatility 11.5% for all strikes.

Furthermore, it can be seen that the increase of time value is not uniform - it is curved - and accelerates as the strike approaches ATM. This 'peaking' makes ATM options relatively expensive compared with OTM.

What all this means is that the choice of the strike rate is very important when assessing an option's worth - the more uncertainty, the more time value - the more expensive the option and vice versa.

To recap this very important aspect of options pricing:

> When an option's strike is ATM (forward), the call and put prices will be the same and consist of the maximum time value attainable for a given level of volatility.
>
> Time value across options strikes with the same maturity is not uniform and accelerates as the ATM level is approached.

We can now return to the calendar spread example and comment on the strategy. The scenario mentioned previously would only produce the projected profit if the second leg were sold ATM in the same way as the first leg (assuming there was no change in volatility). However, any movement of the underlying FX rate away from the strike level would reduce the time value and consequently the profit expectations to the point of possible loss. In fact, this strategy depends on two major assumptions: firstly, that the underlying rate will move very little and, secondly, that volatility (a major component of time value) will remain at, or higher than, the implied purchased volatility of the bought option. The problem here is that volatility is likely to go down if FX rates remain unchanged; clearly this strategy is not as simple as first thought.

For clarity, the option prices displayed in Table 6.3 and shown by graph in Fig. 6.2 have been calculated using a uniform volatility of 11.55% over all strikes. In practice, traded volatilities usually differ according to the distance of the strike from the at the money level, which is another practical factor not consistent with the Black-Scholes model. This aberration is explained below.

Time value adjustment through volatility

It should be noted that the mathematics of option pricing is based on the principle that movement of the FX rate is of a 'random walk' nature resulting in Black-Scholes applying volatility as uniform across all strikes and all maturity terms. However, in practice, FX rates tend to have a bias on the direction (i.e. the rates may 'trend' in one direction or the other) on occa-

sions and also to 'jump' in one direction or the other, causing the implied volatility itself to move. Unless something is done to compensate this, it would be possible, for example, to pick an option strike that is so far out of the money that it would be mathematically impossible for the FX rate to reach the strike (i.e. making it worth exercising) resulting in a zero premium - one could buy an option for nothing!

The result is that the market has to compensate for these inefficiencies in Black-Scholes by adjusting the volatility factor[29] (the only unknown in the options price) for there is no other factor in which to reflect the adjustment. Such adjustments take three forms: the volatility smile, volatility skew and volatility maturity curve.

The volatility smile

The volatility factor applied for pricing out of the money options is usually higher than the volatility applied to options near the money. Furthermore, the amount of mark-up (avoiding the word premium!) of volatility will increase the further the distance from the ATM strike so in reality it is not possible to buy an option for nothing, even if it is mathematically impossible to attain in the money status by maturity. In other words, no bank will sell any option for free!

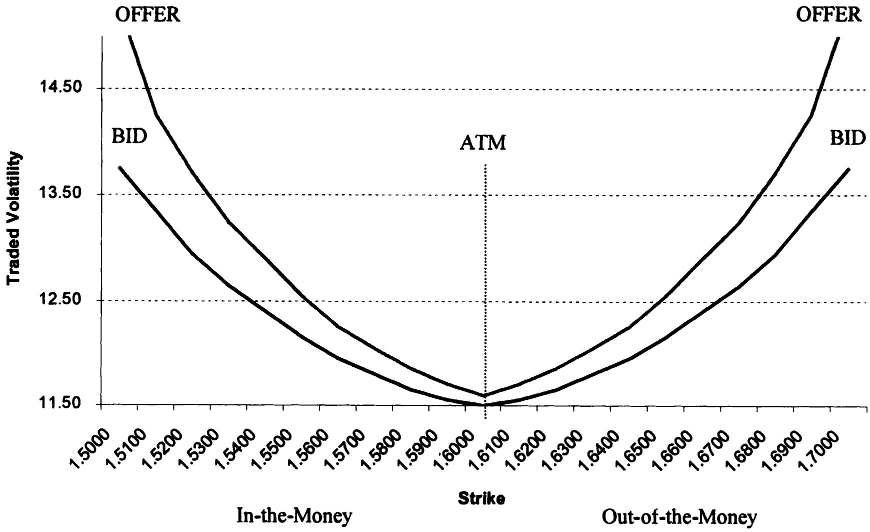
Shown graphically in Fig. 6.3, the volatility level rises on each side of the central, GBP/USD 1.60 ATM strike point.

Figure 6.3 shows the curve of volatility for a GBP call (USD put) option across different strikes but with the same maturity. This increase in volatility is known as the volatility smile or curve across strikes, and is not to be confused with the volatility curve across maturities, which is explained later in this chapter. The two lines in the graph represent the bid, or buying, price and the offer, or selling price. It can be seen that the spread[30] increases as the volatility increases representing less liquidity in the pricing of out of the money and in the money options.

Up to this point out of the money and in-the-money options with higher volatility have been discussed. The severity of the volatility mark-up is determined by the *distance* of the strike from the equivalent at the money strike (point 3 of the main components of time value on page 53) not whether the option is in or out of the money. As already described, an ITM call will have the same time value (and hence, volatility) as the OTM put with the same

29 Reminder: volatility is a major component of time value. Increasing the volatility pricing factor will increase time value and, thereby, the premium of the option.

30 'Spread' is the difference between the bid and the offer rates. Spreads are small, or narrow in liquid markets and large, or wide in illiquid markets.



6.3 Volatility smile - the curve of traded volatility across strikes for a GBP call (USD put), one-month maturity with an underlying FX rate at 1.6000.

Comparative value in terms of traded volatility at different strikes with FX forward rate at 1.600, e.g. at 1.55, the GBP call is 500 points ITM; at 1.65, 500 points OTM. Market spot 1.6043; swap −43 = forward 1.60.

strike through put-call parity. So the distance of the strike from the ATM point is the all-important factor.[31]

All things being equal, the OTM call that is, for example, 5% away from the ATM should have the same relative volatility mark-up as the equivalent OTM put. In other words, one could read the volatility smile in Fig. 6.3 (the curve of traded volatility across *strikes*) as *OTM GBP calls* (USD puts) to the right of the 1.60 strike and *OTM GBP puts* (USD calls) to the left, rather than *ITM and OTM GBP calls* (USD puts).

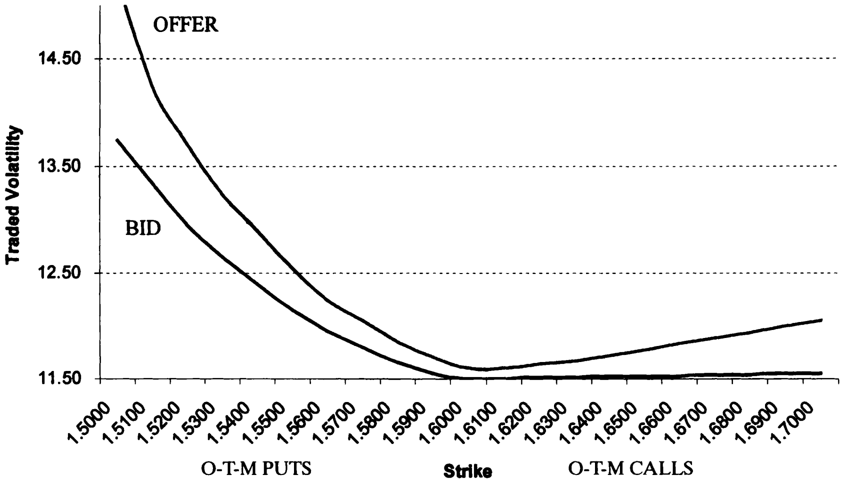
In the market-place, it is normal to always refer to the OTM element of an option - 'I am bid 12.15% (volatility) for the 1.55 GBP puts' (being OTM), rather than 'I am bid 12.15% for the 1.55 GBP calls' (being ITM).

Options traders quoting in volatility terms usually deal in options that are either close to the money, or out of the money. In the money transactions are seldom seen.

The volatility skew (of the smile)

While Fig. 6.3 (the volatility smile) could very easily be the case for a particular currency pair, many volatility smiles are 'skewed' in one direction or

31 This distance is usually measured by reference to the *delta* of the option. Option deltas are covered in Chapter 8.



6.4 Volatility skew - the skew of the smile of traded volatility for a one-month option with an underlying FX rate at 1.60.

The OTM puts have a higher value than the equivalent OTM calls owing to market perception that there is more probability of the FX rate declining than appreciating.

the other if there is a perceived directional bias in the underlying FX rate. For example, a currency may be under devaluation pressures with the potential for either devaluation or retaining the current level of exchange - there is very little chance of any appreciation. In cases like this, the OTM puts would demand a premium over the OTM calls on the currency facing devaluation, and this is adjusted through the volatility mark-up or smile by skewing the volatility higher in favour of the OTM puts. The OTM calls could even be lower than the ATM if devaluation looked probable but, normally, the call line would stay around the ATM level as per Fig. 6.4.

Finally, the reader should note that, as different currency pairs will have different volatilities, so the shape of the smile will be different which, in turn, will affect the skew. Looking at the smile factor: this could be 'flat' with very little mark-up for OTM calls and puts, or severe (shaped like the letter 'U') with very high OTM volatilities compared with ATM. Mathematically, the volatility of a currency pair's traded volatility (yes, the volatility of volatility!) will measure this severity factor so the more volatile the volatility, the more severe (U-shaped) the smile.

The volatility maturity curve

The reader will have noted the curve, and skew of the curve, of volatility *across different strikes* with the same maturity. Volatility is also curved

Table 6.4 Volatility curve through option maturity terms

Term (months)	Traded volatility
1	11.55
2	11.70
3	12.00
4	12.30
5	12.60
6	12.90
7	13.10
8	13.20
9	13.30
10	13.40
11	13.50
12	13.50

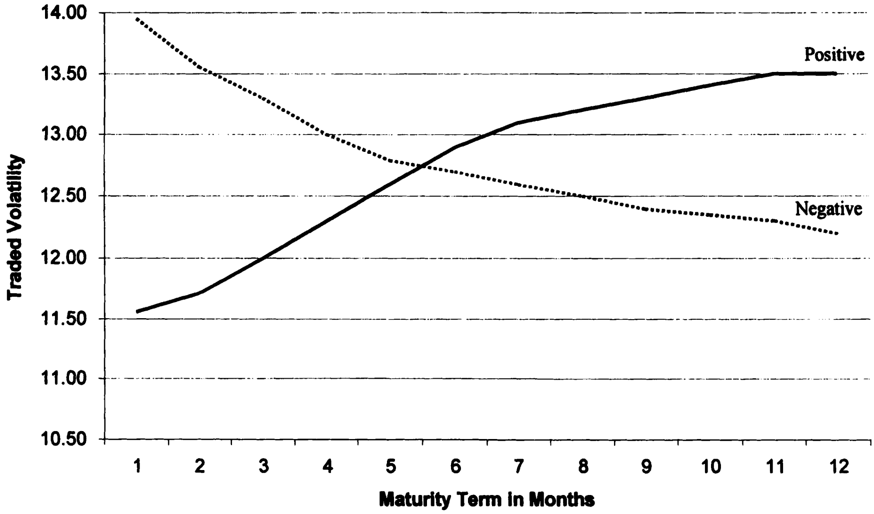
through ***different maturity dates***, so in other words, one-month volatility is unlikely to be the same as one year (although it is possible). Furthermore, the curve may be positive: the higher the volatility levels the longer the maturity; or negative: with higher volatilities in shorter maturity dates. Table 6.4 shows a typical, positive, volatility curve from one month to 12 months.

Option volatility maturity curves may change from positive to negative and vice versa according to the market's perception of the current and future activity of the underlying FX rate. In times of high uncertainty when the spot rate may be fluctuating violently, short-term option volatility rates will rise faster than longer term ones to produce a negative, or inverse, curve. As markets stabilise, volatility rates will fall with shorter terms dropping faster than longer rates to produce the 'normal' positive curve through time. Figure 6.5 shows the graphic representation of Table 6.4's positive volatility curve, together with an example of a negative curve.

Pricing terms

Having calculated the option price from the required input factors,[32] the various pricing terms can be displayed in no less than four ways. Using GBP/USD as an example, these are:

32 Reminder: input factors to price an option are listed at the beginning of this chapter.



6.5 Positive and negative volatility curves - through maturity terms.

1 Per cent of first currency (% of GBP).
2 Second currency in terms of the first (FX points ($)).
3 Per cent of second currency (% of USD).
4 First currency in terms of the second (£ points).

Up to now, we have used expression number 2 (FX points) in the second, or uncertain, currency which is normal market practice for GBP/USD. To obtain the actual premium amount, the price is multiplied by the relevant currency face value of the option.

Example:
GBP 1 mm call (USD 1.6 mm put), one-month maturity, strike 1.60

Using spot of 1.6343, interest rates of 6% (GBP) and 3% (USD) - giving FX forward rate of 1.6000 - and volatility of 11.55%, the results are as follows:

1 % of GBP = 1.3776% of GBP 1 million (premium GBP 13776).
2 221 $ points = GBP 1 million × 0.0221 (premium USD 22100).
3 % of USD = 1.3812% of USD 1.6 million (premium USD 22100).
4 8611 £ points = USD 1.6 million × 0.0086 (premium GBP 13776).

There is no mystery in these results as the premium has to be either GBP 13776 or USD 22100 which implies the current spot rate of 1.6043 (allowing for a small rounding difference). To put this another way, it is possible to convert from one price format to the other by reference to the spot (premium conversion) and strike price (face value conversion). The normal

price term convention in the interbank (OTC) market for the above example is number 2 - FX points.[33]

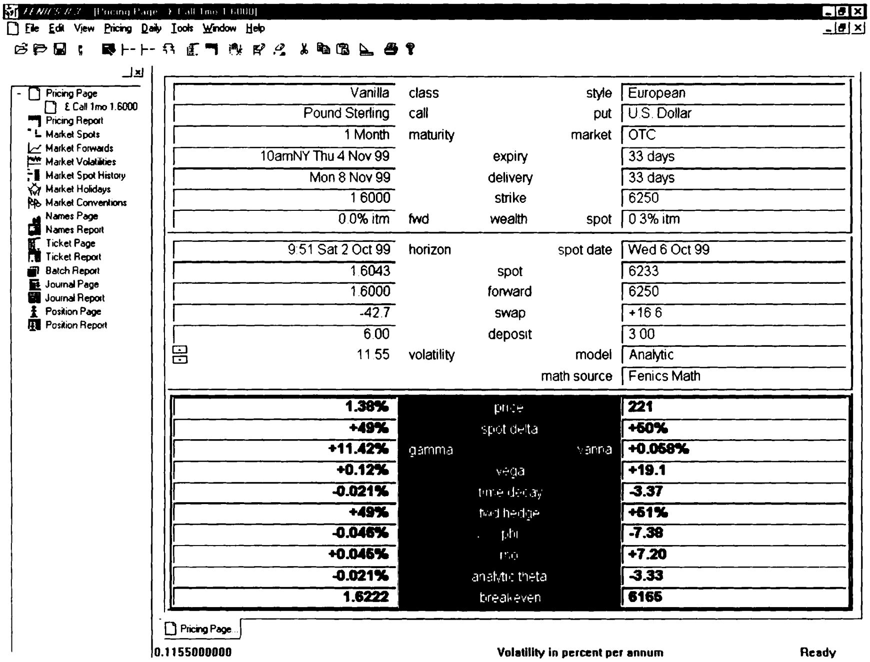
It is normal to quote option prices and their resultant premiums in either of the two currencies within a specified pair. In fact, there is no other method for option pricing unless one introduces another exchange rate for conversion to a third currency and this is not a feature of any option pricing formula, such as Black-Scholes. However, some option users prefer to identify premiums in their particular accounting currency rather than that of the currency pair of the option. This can happen, for example, when a UK company hedges a FX exposure in USD against EUR but wishes to pay for the premium in sterling. This extra conversion is normally held as a separate spot transaction and not held as part of the option premium.

If a premium is paid or received in a third currency, then a further exchange risk arrives in the third currency versus the original premium currency. However, this risk is limited to that of the option's premium value, not the face value of the option.

Pricing systems

Pricing of options using the models described earlier can be achieved by programming the appropriate formulas into a spreadsheet, but most option users find the purchase of a software package is a more convenient method. Software products are available, ranging from simple option calculators through risk analysis models to complete pricing, risk management and accounting systems. In choosing a particular software company, the buyer should be aware of the models presently being used in the market-place as pricing differences between systems have resulted in certain proprietary pricing systems becoming standards for the market-place. For example, in OTC the most generally accepted model is FENICS by Inventure Limited. Over 90% of banks trading options use this software and a copy of the FENICS pricing page is shown in Fig. 6.6. The details displayed are those for the option in the example under pricing terms above.

33 Reminder: the term points is used in FX markets to denote, in most currencies, the fourth decimal place in the exchange rate, i.e. 0.0001, when referring to the difference between spot and forward rates. For example, with spot at 1.6043 and the forward rate at 1.6000, there is a difference of 43 points. Similarly, a *movement* in a rate can also be referred to as points – 'spot has moved up 10 points' – 1.6043 to 1.6053. Hence option premiums may also be expressed in this way. NB: not all currencies adhere to the fourth decimal place rule – it depends on the rate. In JPY, points are the *second* decimal place (110.00 to 110.10 is 10 points).

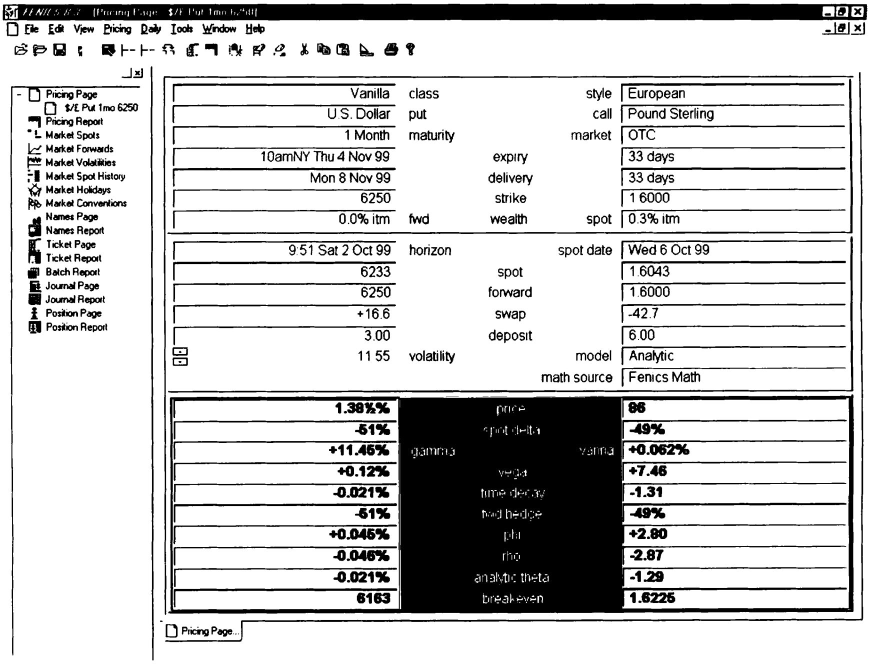


6.6 FENICS pricing page showing details of a one-month GBP/USD 1.6000 call (USD put), price = 221 USD points or 1.38% of GBP.

Ignoring the page tree in the first column, the FENICS pricing page is split into three sections: the top (green) section contains the option details that are chosen such as currency, call or put, maturity and strike; the second (yellow) section has the market rates - spot, forward, interest rates and volatility. The bottom (purple) section shows the results, the option price being on the first line. The rest of the results - the Greeks - are explained in later chapters.

Other markets, such as the PHLX and CME have their own approved models for option revaluation purposes.

This multi-coloured page can be seen in most dealing rooms around the world where FX options are traded. The software is very user friendly and adopts the conventions of the FX market - for example, the price in USD (right-hand column) is shown in 'points' as 221, rather than the mathematical answer of 0.0221. As already mentioned, Fig. 6.6 shows the results for the option used in the pricing terms example (see page 63) for GBP/USD (items 1 and 2 in the list). To read the results for the same option but expressed as USD/GBP (items 3 and 4 in the list), FENICS has the facility to 'flip' from one expression to the other within any given currency pair. Figure 6.7 shows the results of 86 GBP points and 1.38% of USD expressed as USD/GBP. Note the reciprocal strike rate of 0.625 as against the GBP/USD 1.60.



6.7 FENICS pricing page showing details of a one-month USD/GBP 0.625 put (GBP call), price = 86 GBP points or 1.38% of USD.

The same option as in Fig. 6.6 except that it is now expressed as USD/GBP.

Pricing summary

This chapter has deliberately avoided the mathematics of option pricing, except for the one formula from Garman-Kohlgagen. This formula has been included here for record rather than for commentary as there are many books available which are devoted to the subject of option pricing. The void between the theorists and the practical world is quite large in FX options owing, in part, to the fact that the market is very much OTC orientated, leaving little available data on which the academics can base their studies. For example, a year or so ago, the author of this book was present at a conference in Paris attended by some noted theorists, one of whom gave a presentation on option volatility with a conclusion that, in time, volatility could be traded instead of the premium. The OTC market in FX options has traded in volatility terms since 1985!

It should be remembered that the models now available to calculate the price or fair value of an option do just that - calculate the premium, given the input. In the end it is the option dealer at the bank who makes the price, not the model (otherwise we would not need the dealer, it could all be done

by computer). Whether the dealer uses FENICS or another pricing calculator, he or she really does not need to know the mathematics within the system, only that the answer given compares favourably to the prices in the market-place. This is somewhat a 'black box' syndrome and many theorists will argue that an option dealer *must* understand the mathematics behind the price. This is wrong. Does a racing car driver need to understand every detail of what is going on in the engine of the car or is winning the race down to the skill of the driver and what is happening on the track? Would it be better that he didn't know or is a little knowledge a dangerous thing? As long as the engine (pricing system) is proven to be reliable, then it is down to the driver (dealer).

The gap in understanding between the theory and the practice is, however, closing fast with the arrival of the 'quant' (short for quantitative analyst) - a relatively new breed of dealer now to be found in most bank dealing rooms. This person is likely to be in his twenties, academically qualified in mathematics or a similar discipline and has the responsibility of developing and delivering pricing and risk analysis models to cope with the expansion of options and their derivatives (the exotics) in structured transactions for corporate customers. Some of the quants are traders and risk managers, some are salespersons and many are both.

It would seem that the future will require more quants in the dealing rooms as the derivatives markets continue to produce new products that require pricing models.

CHAPTER

7

Using options for hedging: simple

Chapter 2, The basics, gave an example of using a simple bought GBP put (USD call) to cover an underlying exposure to a fall in GBP from the perspective of a UK importer of goods priced in USD. Chapter 3, Option characteristics, provided an example of how selling an option could be considered when owing the underlying currency - in this case a USA company with cash balances in GBP. Chapter 4, Put-call parity, showed the relationship between options and the underlying and how a sold GBP call (USD put) with long GBP FX position can equal the risk profile of a short GBP put (USD call). This chapter expands on the use of basic option strategies and their simple combinations for hedging purposes starting with plain calls and puts.

Calls and puts

Call and put options individually have directional FX risk profiles and, as such, can be used to hedge against adverse exchange rate movements. The bought, or long, call will give protection against a rise in the FX rate, the long put will protect against a fall.

Using the example used earlier of a UK importer with payables of USD 1 000 000 in one month's time, we shall now look at some alternative hedging strategies that the company might want to consider. The corporate treasurer recognises that devaluation in the GBP/USD exchange rate would not be good - a lower rate means paying more pounds for each dollar - and therefore has a long GBP (short USD) FX risk position to hedge. The first step is to look for a strategy that has the opposite underlying risk position - that of being short GBP (long USD). Table 7.1 shows three such strategies plus another, very popular, scenario often employed where FX risk is involved - doing nothing! The results shown reflect the cost in GBP to purchase USD 1 000 000 dependent on the GBP/USD rate in one month's time.

Example:
A UK importer of materials priced in USD has a projected need to buy USD 1 000 000 one month from now. The current forward FX rate is 1.60

Table 7.1 Cost in GBP to purchase USD 1 000 000 under four scenarios.

		Hedging strategies		
FX rate (at expiry)	**Do nothing**	**Sell FX forward GBP**	**Buy option Prem –£12 500 GBP put**	**Sell option Prem +£12 500 GBP call**
1.4000	714 286	625 000	637 500	701 786
1.4200	704 225	625 000	637 500	691 725
1.4400	694 444	625 000	637 500	681 944
1.4600	684 932	625 000	637 500	672 432
1.4800	675 676	625 000	637 500	663 176
1.5000	666 667	625 000	637 500	654 167
1.5200	657 895	625 000	637 500	645 395
1.5400	649 351	625 000	637 500	636 851
1.5600	641 026	625 000	637 500	628 526
1.5800	632 911	625 000	637 500	620 411
1.6000	**625 000**	**625 000**	**637 500**	**612 500**
1.6200	617 284	625 000	629 784	612 500
1.6400	609 756	625 000	622 256	612 500
1.6600	602 410	625 000	614 910	612 500
1.6800	595 238	625 000	607 738	612 500
1.7000	588 235	625 000	600 735	612 500
1.7200	581 395	625 000	593 895	612 500
1.7400	574 713	625 000	587 213	612 500
1.7600	568 182	625 000	580 682	612 500
1.7800	561 798	625 000	574 298	612 500
1.8000	555 556	625 000	568 056	612 500

and the at the money (1.60 strike) option is priced at $200 points, or 2% of face value = £12 500.

The results given in Table 7.1 over the spot range of 1.40–1.80 show that the highest cost of £714 286 is under the 'do nothing' scenario at 1.40. The best possible result of £555 556 at 1.80 is also under this category making do nothing a strong gamble on the exchange rate (note the difference between the best and worst here is some £158 730). A 20 US cent range either side of 1.60 has been used in this example to show results at the extreme of rate movement. In normal markets, one would not expect to see spot trade at such extremes within the relatively short period of a one-month time horizon. However, the FX market is renowned for short, sharp gyrations – 'spiking' – and the question to ask is whether the company is in the business of importing goods or in that of a currency speculator.

The most conservative approach is the purchase of USD forward (sell GBP) at the forward rate of 1.60 which, good or bad, locks in the cost at £625 000. This is the traditional method chosen by most companies to hedge exchange rate risk – negate it completely.

The next step is to consider the option – in this case, the purchase of a 1.60 GBP 625 000 put (USD 1 000 000 call) for a premium of 2% (£12 500) for the one-month term. This option will give the protection needed against a fall in GBP/USD (from 1.60) whilst retaining the beneficial upside for the premium cost of £12 500. Table 7.1 shows this clearly with a maximum cost of £637 500 at all levels of spot at, and below, 1.60 compared with the £625 000 for the forward but at rates above 1.60. This option has all the benefits of the uncovered position, less the premium cost.

Finally, it is worth looking at the scenario of selling the GBP call (USD put). This strategy has an underlying position of short GBP (long USD) and can, therefore, be used as a hedge but the difference in result is quite dramatic as the only factor acting in favour of the hedge is the premium receipt of £12 500. In this scenario the cost is locked in at £612 500 at all rates above 1.60 – still better than the forward – but suffers the same as the do nothing method at all rates below 1.60 lessened by the £12 500 premium receipt.

Table 7.2 shows the difference in profit and loss terms of Table 7.1 by comparing the scenarios against the forward strategy. This clearly shows the relative value of the option purchase against the other strategies – it can never be worse than the premium cost compared to the best possible outcome and, at the same time, guarantee the chosen exchange rate – 1.60 in this case – in the worst possible outcomes. The option purchase would allow the corporate to concentrate on the importing business and still benefit from a favourable exchange rate movement in the event that other

Table 7.2 Profit/loss comparison of scenarios against FX forward in GBP.

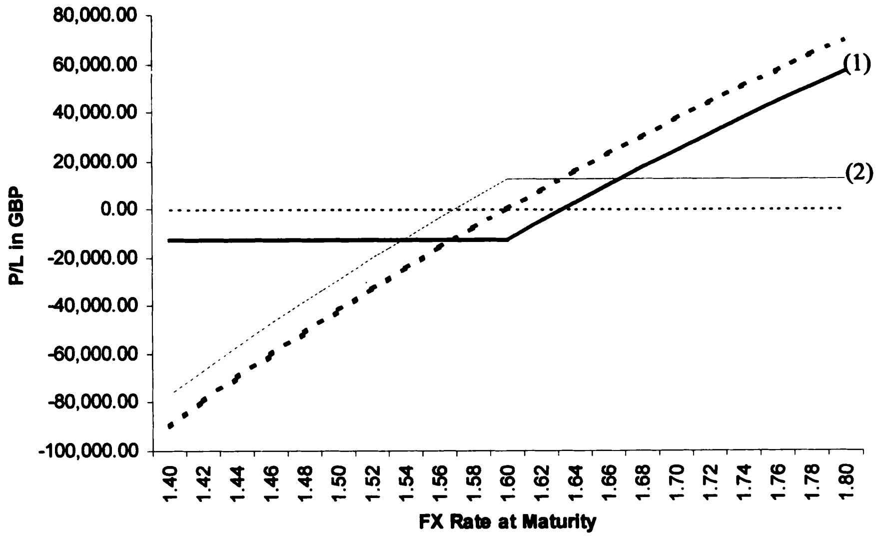
		Hedging strategies		
FX rate (at expiry)	**Do nothing**	**Sell FX forward GBP**	**Buy option Prem −£12500 GBP put**	**Sell option Prem +£12500 GBP call**
1.4000	−89285	0	−12500	−76785.71
1.4200	−79225	0	−12500	−66725.35
1.4400	−69444	0	−12500	−56944.44
1.4600	−59931	0	−12500	−47431.51
1.4800	−50675	0	−12500	−38175.68
1.5000	−41666	0	−12500	−29166.67
1.5200	−32894	0	−12500	−20394.74
1.5400	−24350	0	−12500	−11850.65
1.5600	−16025	0	−12500	−3525.64
1.5800	−7911	0	−12500	4589
1.6000	**0**	**0**	−12500	**12500**
1.6200	7716	0	−4783	12500
1.6400	15243	0	2743	12500
1.6600	22590	0	10090	12500
1.6800	29761	0	17261	12500
1.7000	36764	0	24264	12500
1.7200	43604	0	31104	12500
1.7400	50287	0	37787	12500
1.7600	56818	0	44318	12500
1.7800	63202	0	50702	12500
1.8000	69444	0	56944	12500

Note: *no allowance has been made for interest calculations on the premium paid (in the case of the long put) or received (short call). Option premiums are paid value spot and interest paid or received on this cash-flow will affect the above calculations, decreasing the efficiency of the bought option strategy and increasing the performance of the sold option scenario to a very small degree.*

importers (i.e. the competition) might be unhedged by doing nothing - all for a premium of 2%.

Figure 7.1 gives the graphic representation of Table 7.1. Here we can see put-call parity at work: 1 - the long GBP put (USD call) with the underlying long GBP (short USD) FX at 1.60, producing the classic profile of a long call, and 2 - the short GBP call (USD put) with the same underlying FX position, producing the profile of a short put.

	C − P = FX
1	C = FX + P
2	−P = FX − C



7.1 Profit/loss comparison of strategies against FX forward in GBP.

The action of buying a GBP put whilst long the underlying GBP gives a long GBP call through put-call parity shown here by the classic hockey stick (1) of unlimited profit potential on an increase in the FX rate with limited downside of the premium expenditure. The sold GBP call, together with the same long underlying, gives the same profile (2) of the short put. The underlying long FX position (the 'do nothing' scenario) is shown by the broken line which gives the best payout if GBP rises above 1.64 and the worst, if it falls below 1.58.

Selling options

It can be seen from the last example that there is a case for selling options as a hedge, albeit a weak one. However, selling options in such instances is still better than doing nothing because the payout profile, in the worst case, is always better than the unhedged, do nothing method. A further bonus is added in the sense that the premium receipt (£12 500 in the example) is paid value spot, giving a positive cash flow to the corporate - no allowance has been made for the possible interest to be earned on such.

Chapter 3 gave another example of selling options, in that case a US company sold a 1.60 GBP call (USD put) against cash balances held in GBP - the so-called 'covered call write' (exchange jargon). The idea here was that the US company could earn income from the premium receipt with the worst possible scenario being that the company would sell the pounds at 1.60 through option exercise by the buyer (and buy dollars). As 1.60 was the then current rate of exchange, the company was no worse off than if it had sold the sterling balances, in the first place. This sounds like a no-lose situation but is, in reality, no different than the example earlier in this chapter

- a sold 1.60 GBP call (USD put) with long GBP is a synthetic short GBP put (USD call) - the US company could sell the GBP cash at 1.60, leaving no balances, and sell the GBP put (USD call) for the same premium income. This would leave the company with GBP balances at all rates below 1.60, through the GBP put exercise, and zero above - the same scenario as holding cash and writing a GBP call.

Therefore it is very much a matter of perception. Writing a 'naked' put is speculative and must not be considered but it is perfectly acceptable to do 'covered' call writing! This goes back to the equity option example in Chapter 4 - the most popular strategy in options on stocks and shares is selling covered calls - if one dismisses, or separates, the underlying as an independent 'investment' (e.g. holding balances in GBP), then selling calls is a form of income enhancement, but don't be fooled on this - the risk is there and is the same.

So, perception is a very important factor when considering option strategies. Looking at the two sold option examples highlighted above, one is hedging FX risk (the UK importer) and the other is income enhancement (the US company with GBP cash balance) but both have exactly the same net risk profile - that of a short GBP put (USD call). This is because both companies are long GBP (short USD); the first because of the need to buy USD (a short USD position), the second because of physical cash in GBP (long GBP). After all, in the currency pair GBP/USD, short USD is the same as being long GBP.

Option sales staff at banks can be very astute when it comes to presenting option strategies to corporate clients - if the company treasurer's perception of risk is known, this factor - perception - can be used to construct scenarios with no apparent downside and, sometimes, no cost! Examples will follow in this, and later, chapters.

A note on counterparty credit risk: selling options carries little, or zero, credit risk in the eyes of the seller as the premium received is the maximum to be made on the contract and this is paid at the start, value spot. A corporate wishing to sell options will need to deal with a bank (or banks) that carries a credit line in the name of the company or, alternatively, uses the margin system. Many banks operate margin accounts for lower credit rated companies and, if there are any difficulties, then one can always use the exchange markets.

As we move away from the use of simple calls and puts, we will encounter strategies that involve both buying and selling options as part of a combination scenario - the risk reversal that follows is one such strategy. For the corporate hedger, such scenarios may be viewed as a single transaction for the specific purpose intended but in the books of the banks, and legally, the options will always remain in their component parts - single calls and puts.

The risk reversal

The risk reversal is an OTC originated, directional risk strategy used extensively to hedge FX risk exposure. It is a very simple option combination and has several names. It was originally called a cylinder until a competing bank offered the same product as a range forward and is also known as a collar by some institutions, particularly in the interest rate markets. Risk reversal is the most common name and the professional market term although, between interbank option dealers, a risk reversal carries a simultaneous spot foreign exchange delta hedge[34] (which would defeat the object of using the strategy to hedge foreign exchange exposure).

> The simultaneous purchase of an OTM call with the sale of an OTM put, or vice versa.

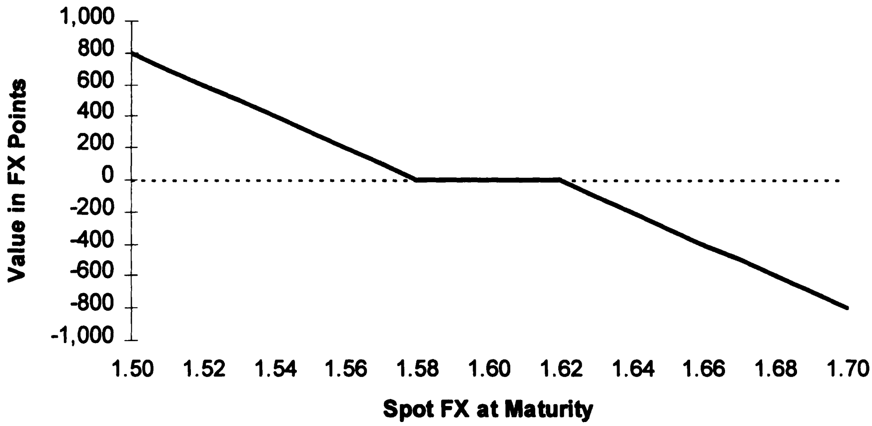
The risk reversal strikes are always set out of the money relative to the forward and generally, in order that the premium received from the written option offsets the cost of the purchased option, produce a zero cost strategy.

It has already been seen in Chapter 4 that the purchase of a call and sale of a put produces a synthetic FX position if the strikes are the same. The setting of different strikes produces a result similar to the FX forward position, except there is a 'range' between the two strikes where there is no position on maturity.

For example, consider the case of a UK company importer who has invoices to pay in US dollars. With the current forward rate at GBP/USD 1.60, there is FX exposure in that the company will reduce invoice costs from a rise in sterling against the US dollar and increase costs from a fall, so hedging is advised. The purchase of a GBP put (USD call) struck at a current forward rate of 1.60 would insure the company against a fall in the GBP but at a cost of around 2.2 US cents in option premium. The company may consider this expense too high for the insurance in view of the fact that it could cover all risk (but give up the potential benefit) by buying USD in the forward FX market at the same rate, without cost.

A compromise might be the risk reversal whereby the company buys a GBP put (USD call) at 1.58 to give a guaranteed minimum level of protection but, at the same time, sells a GBP call (USD put) at a strike level that produces premium income equal to the GBP put premium payment. The result is a zero cost scenario with a short underlying FX directional bias that provides full protection below 1.58, but one which benefits on a rising GBP to the level of the higher, sold GBP call strike, at which point no

34 Delta hedging is explained in Chapter 8.



7.2 Risk reversal (short directional risk) - long 1.58:short 1.62 GBP/USD zero cost.

Risk reversal - combination of long put and short call, but at different strikes. Premium cost of 134 points on the bought 1.58 GBP put (USD call) is offset by premium receipt of like amount on the sold 1.62 GBP call (USD put). Note that the centre of the x-axis is 1.60 - the forward rate.

further benefit is possible owing to the ultimate exercise of the option above that level.

Using a one-month maturity for the example with spot at 1.6043, interest rates of 6% (GBP) and 3% (USD)[35] and volatility of 11.55%, the purchase of a 1.58 GBP put option premium would cost 134 USD points. Within the same parameters, the sale of a GBP call (USD put) to yield 134 USD points would be at a strike of around 1.62,[36] giving the range of this risk reversal as 1.58 to 1.62. Figure 7.2 gives the maturity payout diagram for the bought 1.58: sold 1.62 GBP/USD risk reversal.

This risk reversal looks similar to the straight short FX position, except for the 'gap' between the strikes of 1.58 and 1.62 where neither option is exercised, leaving the company to buy USD (sell GBP) at the prevailing spot rate on maturity. Clearly the best rate for conversion is 1.62 where the underlying exposure gains 200 points over the original 1.60 forward rate, without cost. While this scenario looks reasonable, there is the loss of all benefit above 1.62 and the company is worse-off by 200 points at 1.58 than the original forward. Such a strategy might suit the company treasurer expecting the pound to rise but needing a guaranteed protection level - in this case, 1.58.

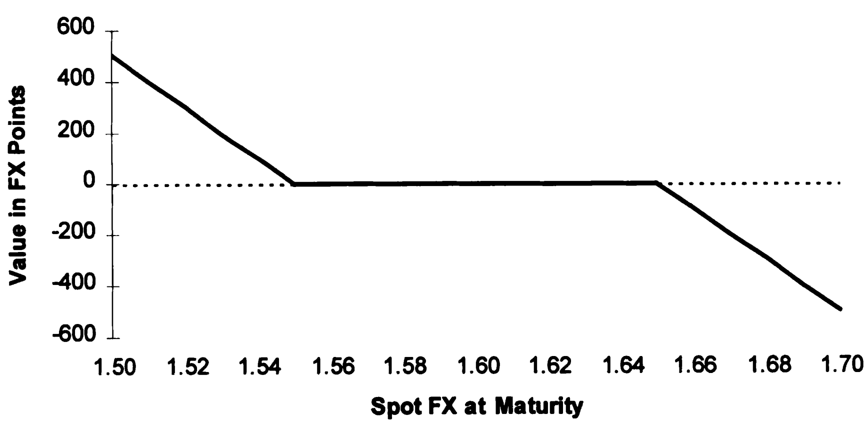
35 These rates would imply a FX forward rate of 1.6000 over a one-month period of 33 days.

36 GBP/USD 1.6200 has been used for simplicity. In reality the 1.62 strike would be slightly higher at 1.6208 using constant 11.55% volatility for that strike.

Choice of strikes

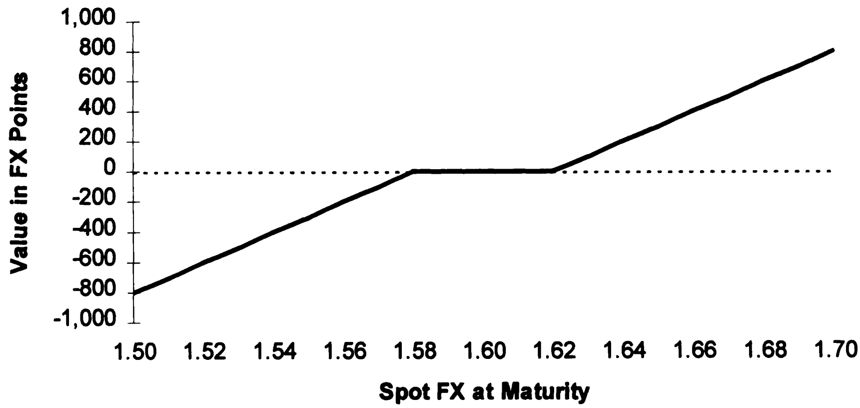
In the above example, we have used the forward FX rate as the starting point to obtain a zero cost risk reversal and we could use other strikes to either narrow or increase the strike range, as long as the two premiums are equal. It all depends on the risk tolerance of the user, because the lower the GBP put strike (more loss), the higher the GBP call strike (more profit), etc. Of course, if the strike range is narrowed to the point of zero, we would be at the forward FX rate of 1.6000 and would have achieved a zero cost, zero strike range risk reversal - a synthetic FX forward through put-call parity.

Figure 7.3 shows a wider range risk reversal with strikes set at 1.55 and 1.65 but still at zero cost - the prime objective. These strikes are further out of the money compared with the previous example of 1.58:1.62 and are thus much cheaper at around 54 USD points. A corporate using this strategy as a hedge against an underlying short position at GBP/USD 1.60 has a larger beneficial impact on a rise in GBP/USD to 1.65 but a correspondingly larger potential negative impact down at 1.55. Nevertheless, the risk reversal does offer a degree of flexibility in terms of risk to the corporate hedger - for example, the corporate treasurer could set the bought strike (the protection level) at the company's budgeted exchange rate which may be out of the money versus the current spot or forward rate. In such a case, there is no apparent downside with a beneficial profit range up to the higher, sold strike level (see presentation on page 78).



7.3 Risk reversal (short directional risk) - long 1.55:short 1.65 GBP/USD zero cost.

Here the premium cost is just 54 points on each of the bought 1.55 GBP put (USD call) and the 1.62 GBP call (USD put). Note that the centre of the x-axis is still 1.60 - the forward rate.



7.4 Risk reversal (long directional risk) - long 1.62 : short 1.58 GBP/USD zero cost.
Risk reversal - this time a combination of long call and short put. Premium cost of 134 points on the bought 1.62 GBP call (USD put) is offset by premium receipt of like amount on the sold 1.58 GBP put (USD call).

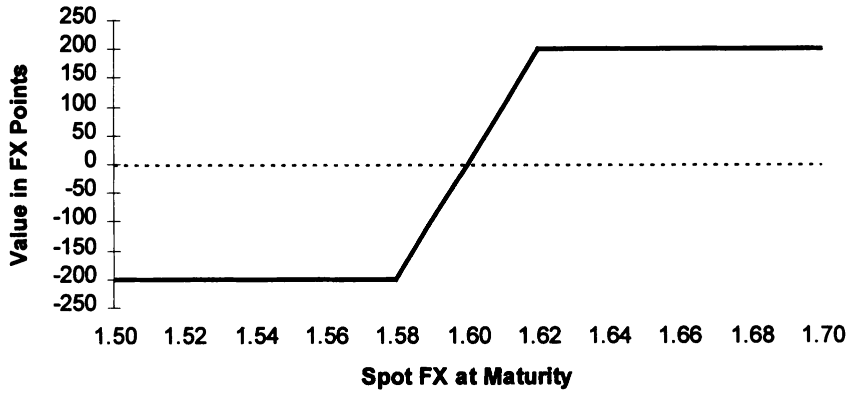
The risk reversal examples discussed above are from the perspective of hedging against a long GBP (short USD) position - the case of a UK importer with payables in USD. Of course, the risk reversal can be constructed to hedge in the opposite direction (e.g. a short underlying position) by purchasing the higher strike - GBP call (USD put) - and selling the lower, GBP put (USD call). This might be considered by a UK corporate with receivables in USD, such as an exporter, and Fig. 7.4 shows the equivalent risk profile of the sold 1.58 : bought 1.62 GBP/USD risk reversal.

In both the hedging examples, the selected strikes of 1.5800 and 1.6200 are the same and set equidistant from the underlying forward rate of 1.6000. This gives a rough guide to the premiums being equal - both strikes are out of the money by the same amount.

Net position

Up to now the risk reversal has been examined from the perspective of hedging both a long underlying position in the case of the UK importer, and a short underlying for the exporter (in GBP terms). If the underlying risk exposure is combined with the chosen risk reversal the net-hedged risk position is arrived at. Looking at the UK importer who buys the 1.58 GBP put (USD call) and sells the 1.62 GBP call (USD put) for zero net premium (as in Fig. 7.5), adding the underlying long GBP (short USD) position at the forward rate of 1.600 gives us the profile in Fig. 7.5 - a bull spread.

The bull spread is a conservative, directional strategy that has limited



7.5 Risk reversal net (long) position - long 1.58:short 1.62 GBP/USD zero cost risk reversal plus long FX forward at 1.600.

Long 1.58:short 1.62 risk reversal with underlying long FX position at 1.60 produces a bull spread.

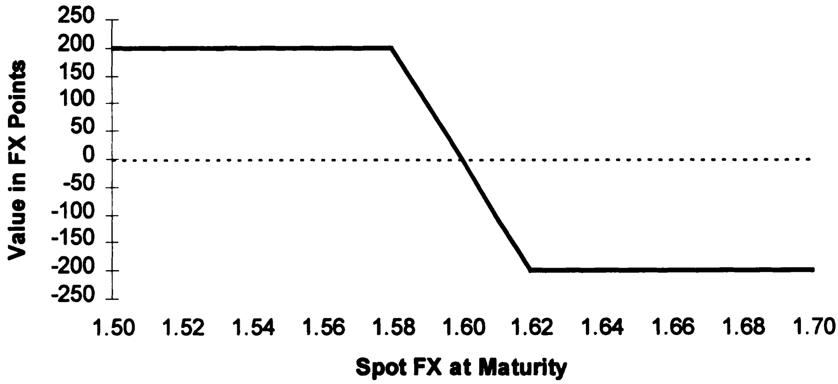
profit and limited loss aspects as can be seen from the diagram. It proves the statement in the earlier example by showing the 200 points maximum gain at 1.62 and corresponding maximum loss at 1.58.

The bull spread is a popular exchange strategy normally constructed by buying an at the money call and selling an out of the money call to reduce overall premium expenditure - the strikes are not set to eliminate premiums as in the risk reversal. The buyer of a bull spread expects the chosen currency to appreciate but not beyond a certain level - the higher, OTM strike.

Similarly, an underlying short position hedged by the risk reversal as in the UK exporter example (Fig. 7.4) will produce a bear spread as in Fig. 7.6. Thus, as far as the corporate hedger is concerned, the risk reversal allows for a little flexibility in the perceived future direction of the FX rate without cost and with known limited loss horizons. Compared to the elimination of risk and inflexibility of the FX outright forward, the risk reversal is a good example of how one may 'manipulate' FX risk through the use of options and, at the same time, incur no cost.

Presentation and perception

A few words here on strategy presentation. The examples given above for risk reversals have used the underlying FX forward rate (GBP/USD 1.6000) as the comparative factor - in other words, the corporate hedger could simply buy or sell at the forward rate so option strategies should always be



7.6 Risk reversal net (short) position - long 1.62:short 1.58 GBP/USD zero cost risk reversal plus short FX forward at 1.600.

Long 1.62:short 1.58 risk reversal with underlying short FX position at 1.60 produces a bear spread.

compared to this.[37] If some other rate is used - a budget rate or even the spot rate - the option strategy payout will give a different picture.

In the past banks have packaged simple option strategies around corporate requirements to hedge at non-market rates such as budget or accounting rates. If such rates are at levels that would present profit compared with the current market forward rate, then it is possible to present all kinds of option strategies that seem 'too good to be true'. Here is an example using the budget rate:

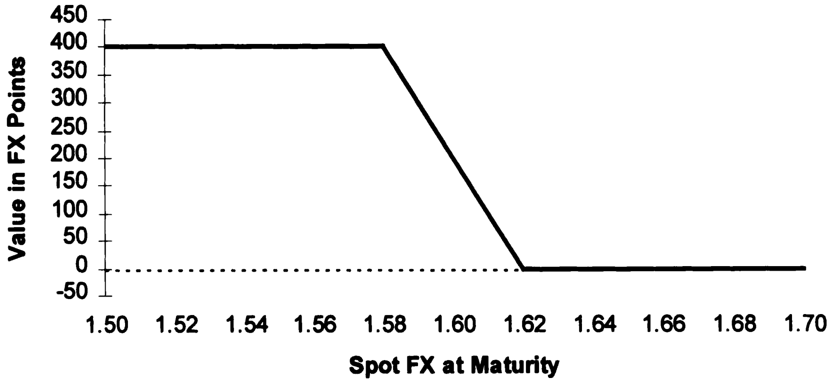
Example:
A UK exporter has USD receivables and is therefore short GBP (long USD) and open to losses should the GBP/USD rate rise. Company policy is to hedge all FX risk, using forwards or options, provided that the budget rate is not exceeded, including any premium costs.

Budget rate 1.6200, current forward 1.6000.

Company buys 1.6200 GBP call (USD put) to gain protection at budget rate and then sells 1.5800 GBP put (USD call) to produce zero cost risk reversal.

Figure 7.7 shows the resultant payout profile using the budget rate of 1.6200. There is no cost attached to this strategy which benefits at all rates below the budget rate to a maximum of 400 points at all rates below 1.5800. A zero cost, no lose situation - the 'free lunch'!

37 Reminder: European-style options are priced on the underlying forward FX rate.



7.7 Risk reversal (net of underlying position) - long 1.62:short 1.58 GBP/USD zero cost risk reversal plus short FX forward at budget rate of 1.6200.

Would you like to buy this scenario? No losses in sight, only possible profits and 'free' to the buyer!

There is nothing wrong with this presentation provided one knows that it is from the perspective of the budget rate and that this rate has 200 points value (at inception) compared to the market, forward rate of 1.6000. So, what has happened is that the 200 points 'profit' (buy GBP forward at 1.6000 will produce 200 points profit against budget) has been absorbed into the payout profile to give the effect of a free lunch.

Using the spot rate

A similar effect can be apparent when using the *spot rate* as the determining factor when there is a large difference between the spot and the forward rate and this is especially true for low traded volatility options. Many corporate companies use the current spot rate when pricing goods and are therefore content to hedge at this rate but, once again, this rate (spot) is not relevant when pricing options - it is the forward rate that matters.

To create the free lunch using spot as the hedge rate, we need the following:

1 A currency pair with a reasonable interest rate differential, say 3% or more.
2 A traded (implied) volatility on the low side, say 10% or lower.
3 A reasonably long option maturity. How long depends on the combination of 1 and 2 above but one year can usually work well.
4 The (FX risk) direction on the *option strategy* to be long the underlying higher yielding currency (and therefore short the low yielding currency). In other words, the company looking to hedge will

have the opposite position - long the lower yielding currency and short the high yielding.

Example:
A UK exporter has won a contract to deliver manufactured goods and receive fixed payment in USD, 12 months from now. Manufacturing costs are in GBP and goods have been priced on the basis of a current exchange spot rate of GBP/USD 1.6043.

12 months fixed interest rates = GBP 6% : USD 3% which gives forward of GBP/USD 1.5595 (on spot of 1.6043).

GBP/USD 12 months traded volatility = 10%.

The company hedges through the following risk reversal:

Long	1.6043	GBP call (USD put)	Premium cost = 419.5 $ points
Short	1.5188	GBP put (USD call)	Premium receipt = 419.5 $ points

The company is fully protected on a rise in GBP/USD at a current spot rate of 1.6043 but benefits from underlying short GBP (long USD) position down to the GBP put strike of 1.5188[38] at no cost. Figure 7.8 shows the payout at maturity in 12 months and is, once again, an apparent free lunch - no losses, only possible profits.

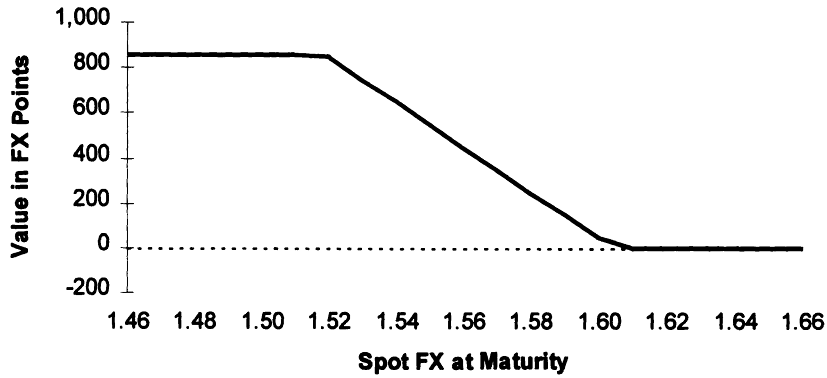
This illustration is much better than the previous (budget rate) example in that, firstly, protection is at 1.6043 (the spot rate), rather than 1.6200, and, secondly, the range is wider (down to 1.5188) giving higher potential profits of 800+ USD points at all rates below the put strike of 1.5188.

As before, there is nothing wrong with this presentation, provided one knows that it is from the perspective of the spot rate and that this rate is 448 points above the forward rate of 1.5595 - the rate used to price the options in the risk reversal. The 1.6043 GBP call (USD put) is an at the money spot (ATMS) option but at the same time is also an out of the money, forward (ATMF) option and therefore cheaper.[39]

So this time, using the spot rate instead of the forward gives the apparent free lunch and is much better because the difference between spot and the forward is some 448 points, compared to 200 between the budget rate and forward in the previous example.

38 The choice of this rather unusual strike rate is explained later under 'How to deal in risk reversals'.

39 Reminder: ATMF options have the highest time value (see Chapter 6, Time value).



7.8 Risk reversal (net of underlying position) - long 1.6043:short 1.5188 GBP/USD zero cost risk reversal plus short FX at spot rate of 1.6043.

Another 'something for nothing' risk reversal - this time structured on the current spot rate.

How to deal in risk reversals

This section gives a guide to the market practice when dealing risk reversals for hedging purposes, given a known amount at risk (the option face value, or hedged amount in currency terms) and term (the option maturity).

The first consideration is the level of the strike rate of the purchased option as this provides the protection needed against an unfavourable movement in the underlying FX rate. As can be seen from the earlier examples, this strike might be at a budget rate, a maximum tolerance rate, the current spot rate or other, such as a chart point.

The second consideration is one of cost. Risk reversals are normally constructed at zero cost but the corporate may wish to increase the strike range whilst keeping the 'protection' strike at a given level - this will produce a net premium payable according to the chosen sold strike rate. In the same manner, one can also construct risk reversals to produce a net premium receipt by narrowing the strike range.

Whether zero cost, net premium payable or receivable, the first consideration - the bought strike rate - should be the anchor for, once this has been fixed, the rest is relatively easy:

1 Contact a bank and ask for a risk reversal based on the following details: (see page 83)
2 Ask the bank to calculate the other (sold) strike rate on an indication basis. Note the result.

		Example
(a)	Currency pair	GBP/USD
(b)	Amount	USD 1 000 000
(c)	Term	1 month
(d)	Chosen strike	1.62
	Buy	GBP call (USD put)
(e)	Net cost	Zero
(f)	Spot reference (current spot rate)	1.6043

3 Contact at least one other bank and give the same details. Compare the sold strike rates offered.
4 Transact the risk reversal at the bank where the offered (sold) strike gives the widest range against the chosen strike. Bear in mind that if the spot rate subsequently moves from the reference level, the actual sold strike will be better or worse - but you are dealing with the bank offering the most value in option terms.

Note (f) - the spot reference - is included to make the comparison of strike more accurate. As it is a directional strategy, the risk reversal is strongly influenced by spot rate movement. However, if each bank uses the same spot reference, the only variable is the traded (implied) volatility (at each of the strikes) - traded volatility rates are far more stable than spot FX. Ask the first bank called for this spot reference rate, or choose it yourself in which case be careful to use the correct side (bid or offer). If you are covering a short underlying position, use the offered side of spot for that currency; bid side if you are long.[40] If in doubt, always use the bank spot reference.

Note 2 - the GBP put (USD call) strike, is implied from the 1.6200 GBP call (USD put) strike premium from details given. This is why the GBP put strike of 1.5188 was not a rounded number in the last example - it is the exact strike to equate the same premium as the GBP call.

Note 2 - indication rates or prices cannot be dealt upon but are intended to give a good idea of what might be expected when asking for a dealing or 'live' price. As it is indicative only, the bank trader is under no pressure of price change and will be more relaxed (and interested) in what

40 Remember that FX can be quoted in two ways and that bid for one currency is the offer for the other – e.g. in GBP/USD 1.6038–43, the offer for GBP at 1.6043 is the bid for USD – this 'side' of spot would be used if short GBP (long USD).

you are trying to achieve. This will aid competitiveness when the time comes to deal.

The above procedure is recommended for those corporate entities that do not have access to option pricing software. The process can be improved further through a separate spot transaction at a given level of spot that would be reversed on dealing the risk reversal with the bank. This is discussed later in Chapter 9, OTC market practice.

The purchase of option pricing/risk management software, such as Corporate FENICS, would reduce risk reversal pricing to a volatility quote based on the approximate deltas of the two strikes. Risk reversals are traded extensively in the interbank market in volatility terms to reflect the skew of the volatility smile (Chapter 5) and this is thus a very liquid market. The use of pricing software alone would allow the corporate to take full advantage of this liquid market and have full control over the choice of strike, cost and risk.

Chapter 9, OTC market practice, and Chapter 10, Bank relationships, expand on how the corporate can take advantage of option markets through the better understanding of the practices and counterparty relationships.

Participating forwards

The participating forward, also known as a profit sharing forward, is another popular OTC strategy used extensively for hedging.

> The simultaneous purchase of an OTM call (or put) with the sale of an ITM put (or call) at the same strike but with different face values.

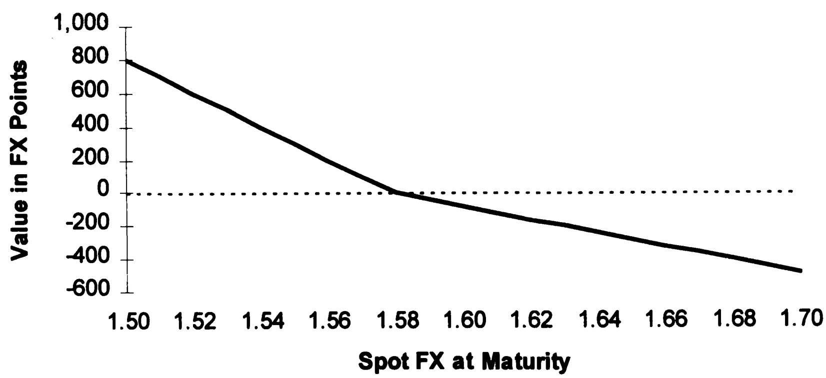
This time, the strike is the same but the call and put options have different face values (amounts) and, like the risk reversal, a participating forward can be constructed with zero or reduced premium (or even premium income to a limited extent) and this is the main attraction of the strategy. In addition, it has a certain appeal in that full hedging cover is provided in one direction but should spot move favourably, only a proportion of the potential profit is given up.

Using the prior example of the UK importer who has an underlying long GBP (short USD 1 000 000) position and picking the same one-month, 1.58 GBP put (USD call) option as the risk reversal example, the zero cost participating forward is constructed as follows:

Buy	1.58 GBP put (USD call) Face value USD 1 000 000 (GBP 632 911.39)	To give protection against fall in GBP Option price = 134 USD points Premium cost = USD 8481.01[41]
Sell	1.58 GBP call (USD put) Face value USD 401 198 (GBP 253 922.53)	To receive premium Option price = 334 USD points Premium receipt = USD 8481.01[42]

Buying a put and selling a call with the same strike and maturity date would replicate a short FX position through put-call parity but the participating forward has *different amounts*. Zero premium cost is achieved by selling the ITM option (the GBP call in the example) for a proportional amount (just over 40% in this case) of the OTM option (the GBP put) in order that the two premiums equate to zero.

Note that the ITM GBP call (USD put) is 200 points more than the OTM GBP put (USD call) - the intrinsic value of the strike (1.58) to the underlying forward rate of GBP/USD 1.6000. The time value of both the call and put is thus 134 points.



7.9 Participating forward - long 1.58 GBP put (USD 1 000 000 call) and short 1.58 GBP call (USD 401 198 put), one-month maturity.

100% protection is gained at all rates below 1.58 but losses in excess of that rate are at 40%.

Figure 7.9 shows the graphic representation of this example. Note that the importer is fully protected at 1.58 and below by the GBP put (USD call) but the loss on the GBP call (USD put) above that level is restricted to only 40% of the underlying FX position. Therefore, the exporter benefits by sterling appreciation to 60% of the unhedged position (hence 'participating' or 'profit sharing' forward).

41 Calculated by GBP 632 911.39 × 0.0134 = USD 8481.01.

42 Calculated by GBP 253 922.53 × 0.0334 = USD 8481.01.

As with the risk reversal, the participating forward has the effect of manipulating the underlying FX directional risk profile. The risk reversal created a range where the corporate hedger gained some flexibility; the participating forward gives no range but a differing profit/loss ratio.

Choice of strikes

The choice of the strike determines the amount of risk taken and the amount of participation. Keeping with the above example, the choice of the 1.58 GBP put (USD call) strike with the underlying FX rate at 1.60 gives a 60% participation at a 'cost' of 200 points (the forward is better than the strike by this amount).[43] 'Cost' here is in the context of potential opportunity loss as there is no premium payment - in other words, protection against the GBP declining starts at 1.5800 against the current forward rate of 1.60.

In this example, the lower the strike, the higher the participation and the higher the opportunity loss. For example, a 1.56 strike would increase the participation to just over 84% by selling just 15.7% of the GBP call (USD put) but now there is 400 points opportunity loss (underlying rate of 1.60 – 1.56). Figure 7.10 gives the graphic representation of this.

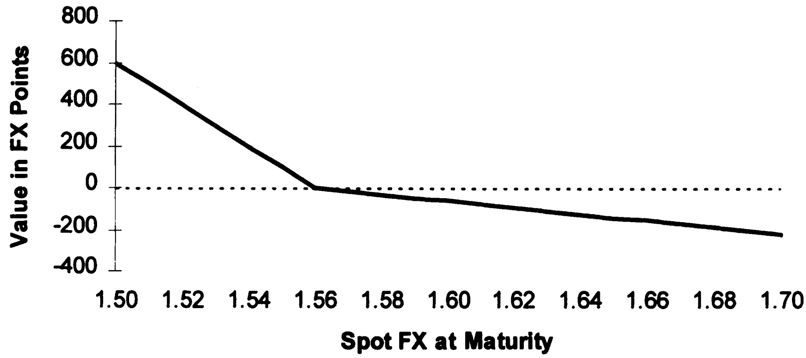
If we were to move the strike *up* from 1.58, then participation would decrease (and the opportunity loss also decrease) to the point by zero per cent at 1.60 where the cost to cover the bought 1.60 GBP put (USD call) would equal the sold GBP call (USD put) at 100%. Of course, at this point the participating forward disappears as we would have attained a synthetic short FX position through put-call parity (+P – C = –FX) and hedged the underlying long GBP (short USD) completely.

Net position

Figure 7.11 shows the payout profile for the 1.58 GBP/USD 60% participating forward example with the underlying risk position - long GBP (short USD) at the forward rate of 1.60.

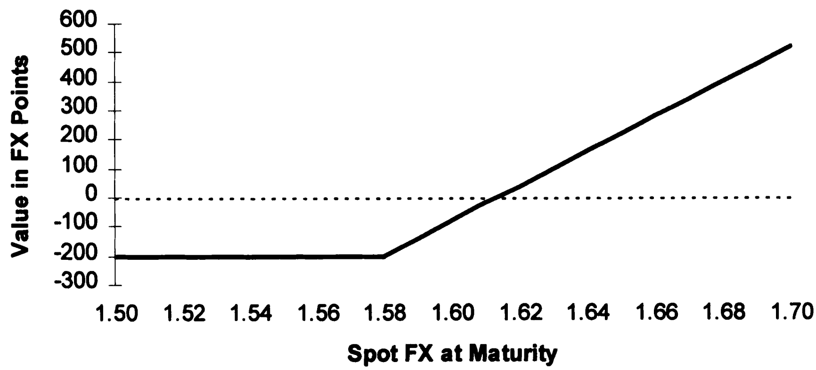
At first glance, Fig. 7.11 looks like a classic long 1.58 GBP call (USD put) but it is not so. Firstly, the profit profile to the right of the 1.5800 rate on maturity is increasing at the rate of 60% of the FX rate increase (rather than 100%). At 1.70, one would expect profit of 1000 points being 1.70 – 1.58 – 200 'premium'. It is, in fact, only 520 points from 60% × (1.70 – 1.58) = 720 – 200 'premium'. Secondly, there is no premium - this partici-

43 Reminder: it is better to sell GBP (buy USD) at 1.60 than 1.58 (buy high/sell low).



7.10 Participating forward - long 1.56 GBP put (USD 1000000 call) and short 1.56 GBP call (USD 156800 put), one-month maturity.

100% protection is gained at all rates below 1.56 but losses in excess of that rate are at just 15.7%.



7.11 Participating forward (net position) - long 100% 1.58 GBP put (USD call), short 40% GBP call plus underlying long GBP (short USD) at forward rate of 1.60, one-month maturity.

This looks very much like a regular long call with the maximum loss of 200 points but this participating forward is zero cost, so where does this 'loss' come from?

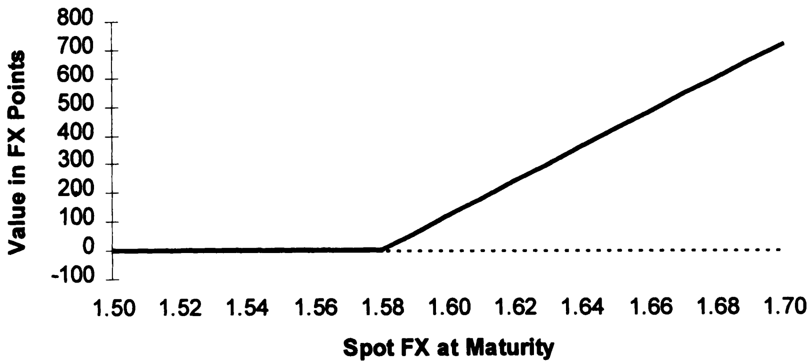
pating forward is a zero cost structure! The 200 maximum loss to the left of 1.58 in the diagram is not premium paid but the opportunity loss versus selling GBP (buying the USD 1000000) at the forward rate of 1.60, in the first place.

Similar to the risk reversal, the fixed outright rate of 1.60 is given up in preference for a minimum of 1.58, but providing 60% of any profits above that level.

Presentation and perception

As with the risk reversal, the participating forward can be presented as a 'no lose' strategy by using a rate other than the current forward to represent the underlying FX exposure. Using the last example, if GBP/USD 1.5800 is the company budget rate, or the rate used to cost the import (for sales in GBP), the payout is as displayed in Fig. 7.12.

Note that Fig. 7.12 is from the perspective of the UK importer - underlying long GBP (short USD) position at 1.5800.The example for the risk reversal in Fig. 7.7 was for the UK *exporter* with underlying short GBP (long USD), hence profits are in the opposite direction.



7.12 Participating forward (net position) - long 100% 1.58 GBP put (USD call), short 40% GBP call plus underlying long GBP (short USD) at rate of 1.5800, one-month maturity.

The ultimate free lunch - nothing to lose and everything to gain (if the pound goes up)!

How to deal in participating forwards

This section gives a guide to the market practice when dealing participating forwards for hedging purposes, given a known amount at risk (the option face value, or hedged amount in currency terms) and term (the option maturity).

As with the risk reversal, the first consideration is the level of the strike rate of the purchased option as this provides the protection needed against an unfavourable movement in the underlying FX rate and also determines the participation. As seen from the earlier examples, such strike might be at a budget rate, a maximum tolerance rate, the current spot rate or other, such as a chart point.

The second consideration is one of cost. Participating forwards are normally constructed as zero cost but the corporate may wish to increase the

participation whilst keeping the strike at a given level - this will produce a net premium payable according to the chosen participation (or a calculated participation given a known amount of premium). In the same manner, one can also construct participating forwards to produce a net premium receipt by decreasing the participation.

Whether zero cost, net premium payable or receivable, the first consideration - the strike rate - should be the prime factor for, once this has been fixed, the rest is relatively easy:

1 Contact a bank and ask for a participating forward or profit sharing forward based on the following details:

		Example
(a)	Currency pair	GBP/USD
(b)	Amount	USD 1 000 000
(c)	Term	1 month
(d)	Chosen strike	1.58
	Buy 100%	GBP put (USD call)
(e)	Net cost	Zero
(f)	Spot reference (current spot rate)	1.6043

2 Ask the bank to calculate the participation ratio on an indication basis. The face amount of the ITM sold option will be 100% minus the participation ratio. Note the result.
3 Contact at least one other bank and give the same details. Compare the participation ratios offered.
4 Transact the participating forward at the bank where the offered participation is highest. Bear in mind that if the spot rate subsequently moves from the reference level, the participation will be better or worse - but you are dealing with the bank offering the most value in option terms.

Note (f) - the spot reference - is included to make the comparison of strike more accurate. As it is a directional strategy, the participating forward is strongly influenced by spot rate movement. However, if each bank uses the same spot reference, the only variable is the traded (implied) volatility for the given strike - traded volatility rates are far more stable than spot FX. Ask the first bank called for this spot reference rate, or choose it yourself, in which case be careful to use the correct side (bid or offer). If you are covering a short underlying position, use the offered side of spot for that currency; use the bid side if you are long (see footnote 40). If in doubt, always use the bank's own spot reference rate.

Note 2 - Indication rates or prices cannot be dealt upon but are intended to give a good idea of what might be expected when asking for a dealing or 'live' price. As it is indicative only, the bank trader is under no pressure of price change and will be more relaxed (and interested) in what you are trying to achieve. This will aid competitiveness when the time comes to deal.

The above procedure is recommended for those corporate entities that do not have access to option pricing software. The process can be improved further through a separate spot transaction at a given level of spot that would be reversed on dealing the participating forward with the bank. This is discussed later in Chapter 9, OTC market practice.

The purchase of option pricing/risk management software such as Corporate FENICS would reduce participating forward pricing to a volatility quote based on the approximate delta of the OTM (bought) option. Chapter 9, OTC market practice, and Chapter 10, Bank relationships, expand on how the corporate can take advantage of option markets through better understanding of the practices and counterparty relationships.

Seagulls

The risk reversal has two options at different strikes: one bought option and one sold option of equal amounts. The participating forward has two options at the same strike: one bought option and one sold option of unequal amounts. The seagull has three options, all at different strikes: one bought and two sold or two bought and one sold of equal amount. All three strategies have directional risk profiles and are usually constructed at zero cost.

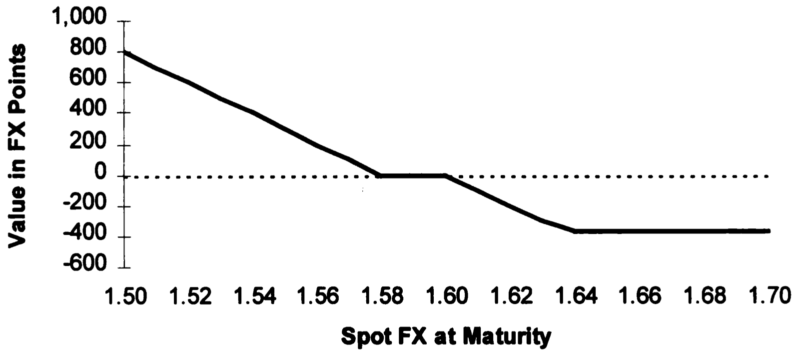
The seagull became popular in the early 1990s as an extension of the risk reversal - the addition of the third strike limiting the downside risk.

> A risk reversal with an additional third strike that (usually) limits potential losses.

Using the prior example of the UK importer and choosing the same 1.58 GBP put (USD call) to provide the protection needed against a devaluation in GBP, a zero cost seagull might be constructed as follows:

1 Buy	1.5800	GBP put (USD call)	Premium cost = (134) points	Provides protection
2 Sell	1.6000	GBP call (USD put)	Premium receipt = 221 points	Pays for (1) and (3)
3 Buy	1.6365	GBP call (USD put)	Premium cost = (87) points	Limits downside

All options of one-month maturity



7.13 Seagull - long 1.58 GBP put (USD call), short 1.60; long 1.6365 GBP calls (USD puts), net premiums to equal zero, one-month maturity.

The 1.58 GBP put provides full protection against a fall from that level, as in the risk reversal, but losses on a rise in GBP are limited by the purchase of the OTM GBP call at 1.6365.

This seagull gives the payout profile in Fig. 7.13. Note that, in this example, the original risk reversal case study of a sold 1.62 GBP call has been reduced to a strike of GBP/USD 1.60 to pay for the third option (at 1.6365). The 1.60 strike is ATM (forward) and therefore commands the higher premium receipt of 221 USD points.

Choice of strikes

With seagulls we are looking at three possible strikes and the choice begins to get a little more complex. The first strike choice has to be the purchased option at a rate where protection against an underlying position is needed. In the example this is at GBP/USD 1.5800.

The next two strikes - one sold and one bought - can then be juggled in order to produce a zero cost across all three options. The example uses a sold option at 1.60 (ATMF) which computes to a bought 1.6365 to square[44] all premiums to zero. One could have chosen the highest strike - say 1.6500 - and computed the middle strike (at around 1.6062) to equate to a net zero premium cost.

Seagulls, like risk reversals and participating forwards, can be constructed for a given premium expenditure or even premium receipt but, in most cases, the objective is for a zero net premium.

The seagull demonstrates further how it is possible to manipulate the

44 In dealing jargon, to be 'square' is to have a net position of zero following two or more transactions. It is analogous to 'flat' or 'par'.

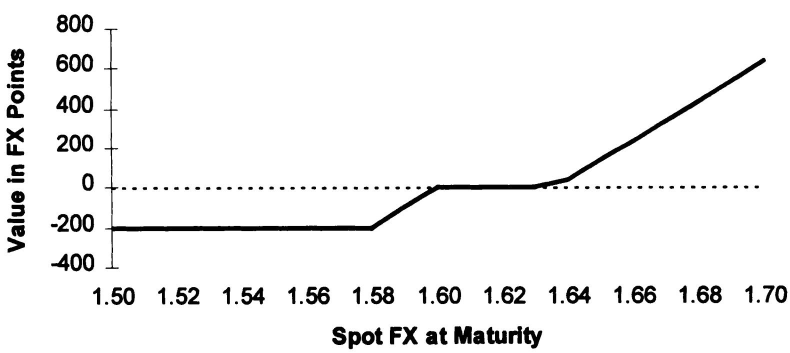
straight-line nature of FX risk by using options. The more strikes involved, the more the manipulation, the more flexibility offered and the more complicated the strategy.

Ultimately the choice of strikes depends entirely on the user's perception of where the underlying FX rate is likely to be on maturity, balanced against the requirements to hedge, and at what rate and cost.

Net position

Staying with the prior example of the bought 1.58GBP put (USD call) : short 1.60GBP call (USD put) and long 1.6365GBP call (USD put), we can now look at the net position by including the underlying FX risk of the UK importer - long GBP (short USD) at the forward rate of 1.60. Figure 7.13 gives the graphic representation of the combined scenario.

Although the seagull in Fig. 7.14 has a fairly wide range of strikes between 1.58 and 1.6365 for the one-month maturity, it does offer a reasonable profile of risk. The only negative aspect is the ultimate sale of GBP (purchase of USD) at 1.58 or below by the importer exercising the GBP put (USD call) - this being the opportunity loss of selling GBP at 1.58 compared with the possible 1.60 at inception. Between 1.58 and 1.60, nothing happens and the GBP is sold at market to produce the USD required to pay for the importer's goods. At 1.60 and all rates up to 1.6365, the importer sells GBP at a fixed rate of 1.60 by being exercised (i.e. by the buyer) on the sold 1.60



7.14 Seagull (net position) - long 1.58 GBP put (USD call), short 1.60; long 1.6365 GBP calls (USD puts), net premiums to equal zero plus underlying long GBP (short USD) at 1.60, one-month maturity.

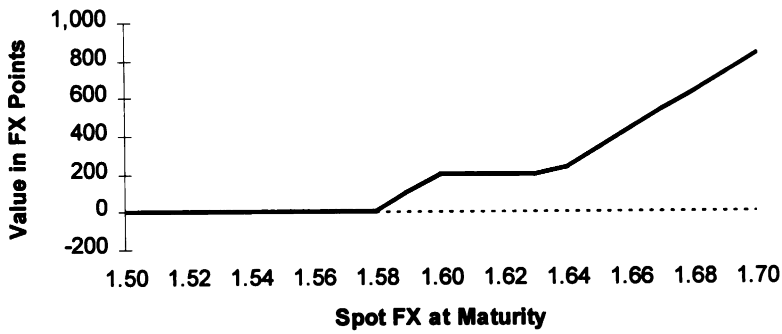
This seagull gives protection below 1.58 at maximum opportunity loss of 200 points (underlying forward of 1.60 - strike 1.58), has no risk effect between 1.60 and 1.6365 but offers unlimited profit potential at all rates above the highest strike.

GBP call (USD put). Between these rates (1.60–1.6365) there is no difference from dealing the forward at 1.60 at inception. Above 1.6365, the GBP is sold at the current spot but a loss of 365 points is incurred through buying GBP at 1.60 (exercise by buyer of 1.60 GBP call) and selling GBP at 1.6365 (by exercising the bought GBP call at that level). The effective exchange rate above 1.6365 is therefore the current spot rate less 365 points; for example, at 1.6500, the importer produces GBP and buys USD at 1.6135.

Presentation and perception

As with the risk reversal and the participating forward, the seagull can be presented as a no lose strategy by using a rate other than the current forward to represent the underlying FX exposure. Using the last example, if GBP/USD 1.5800 is the company budget rate, or the rate used to cost the import (for sales in GBP), the payout is as displayed in Fig. 7.15.

The seagull examples (Figs. 7.13, 7.14 and 7.15) give the perspective of using this strategy to cover an underlying FX position of long GBP (short USD) - the case of the UK importer needing to buy USD (and thus sell GBP). As with any FX directional risk strategy, the seagull may be constructed to hedge an underlying position in the opposite direction - in this case that of being long GBP (short USD), as would be the case for the UK exporter with receivables in USD.



7.15 Seagull (net position) - long 1.58 GBP put (USD call), short 1.60; long 1.6365 GBP calls (USD puts), net premiums to equal zero plus underlying long GBP (short USD) at 1.58, one-month maturity.

Another 'no-lose' scenario created by using an underlying rate of GBP/USD 1.58 with forward at 1.60.

How to deal in seagulls

This section gives a guide to the market practice when dealing seagulls for hedging purposes, given a known amount at risk (the option face value, or hedged amount in currency terms) and term (the option maturity).

As with the risk reversal and participating forward, the first consideration is the level of the strike rate of the purchased option as this provides the protection needed against an unfavourable movement in the underlying FX rate. As seen from the earlier examples, such strike might be at a budget rate, a maximum tolerance rate, the current spot rate or other, such as a chart point.

The second consideration is one of cost. Seagulls are normally constructed as zero cost but the corporate treasurer may wish to increase the beneficial effects of the bought options by choosing strikes that have the effect of increasing the premium paid or by choosing strikes that reduce the premium receipt on the sold. In the same manner, one can also construct seagulls to produce a net premium receipt by increasing the negative effects of the options strike rates.

The third consideration is the level of the second and third strike rates. As previously stated (see 'Choice of strikes' on page 91), this is very much a matter of choice versus risk perception.

Whether zero cost, net premium payable or receivable, the first consideration - the protection strike rate - should be the prime factor. When this has been chosen:

1 Contact a bank and ask for a seagull based on the following details:

		Example
(a)	Currency pair	GBP/USD
(b)	Amount	USD 1 000 000
(c)	Term	1 month
(d)	Chosen protection strike	1.58
	Buy	GBP put (USD call)
(e)	Choose either:	
	(i) Sold (middle) strike	1.60
	(ii) Bought (top) strike	1.6365
(f)	Net cost	Zero
(g)	Spot reference (current spot rate)	1.6043

2 Ask the bank to calculate the third strike on an indication basis. Note the result.

3 Contact at least one other bank and give the same details, including the spot reference rate. Compare the strike rates offered.

4 Transact the seagull at the bank where the third strike is the more beneficial. Bear in mind that if the spot rate subsequently moves from the reference level, the participation will be better or worse - but you are dealing with the bank offering the most value in option terms.

Note (g) - the spot reference - is included to make the comparison of strike more accurate. As it is a directional strategy, the seagull is strongly influenced by spot rate movement. However, if each bank uses the same spot reference, the only variable is the traded (implied) volatility across the three strikes - traded volatility rates are far more stable than spot FX. Ask the first bank called for this spot reference rate, or choose it yourself, in which case be careful to use the correct side (bid or offer). If you are covering a short underlying position, use the offered side of spot for that currency; use the bid side if you are long (see footnote 40). If in doubt, always use the bank's own spot reference rate.

Note 2 - indication rates or prices cannot be dealt upon but are intended to give a good idea of what might be expected when asking for a dealing or live price. As it is indicative only, the bank trader is under no pressure of price change and will be more relaxed (and interested) in what you are trying to achieve. This will aid competitiveness when the time comes to deal.

The above procedure is recommended for those corporate entities that do not have access to option pricing software. The process can be improved further through a separate spot transaction at a given level of spot that would be reversed on dealing the seagull with the bank. This is discussed later in Chapter 9, OTC market practice.

The purchase of option pricing/risk management software such as Corporate FENICS would reduce the seagull pricing to a volatility quote based on the approximate deltas of the three options. Chapter 9, OTC market practice, and Chapter 10, Bank relationships, expand on how the corporate can take advantage of option markets through better understanding of the practices and counterparty relationships.

Designing a strategy

Risk reversals, participating forwards and seagulls are all combinations of plain vanilla options and have proven to be the most prevalent of the simple hedging strategies in the past. More recently, these strategies have been used together with knockout barriers to further reduce premiums and/or extend

Table 7.3 List of variables for designing a strategy.

	Example	Result
1 Number of strikes	Seagull	3
2 Choice of strike rates	Risk reversal	Range width
3 Calls or puts	Risk reversal	Risk direction
4 Buy/sell	Seagull	Limited or unlimited risk
5 Amount/ratio	Participating forward	Participation
6 Amount of premium cost	Zero cost	FX risk manipulation
7 Perceived movement of spot FX	Direction and degree	Risk/reward

the beneficial aspects (range, ratio, strike, etc). The barrier option is the most popular of the exotic range and is discussed in detail in Chapter 11, Using options for hedging: intermediate, so we will keep to the simple combinations in the current chapter.

Assuming that we want to design a strategy for hedging purposes, we have a choice of combining any or all of the factors listed in Table 7.3.

Given the number of variable factors, the possibilities are almost unlimited. It all depends on what one is looking for, but the most important considerations for *hedging strategies* are listed in Table 7.4.

For example, if we chose the number of strikes as four (variable 1 in Table 7.3) and zero cost as a determination (decision 1 in Table 7.4) and wanted to hedge against a decline in the FX rate, we could construct the following and give it the name of a double risk reversal.[45]

Example 1:
Buy 1.58 GBP put (USD call) for 134 USD points.
Sell 1.54 GBP put (USD call) for 37 USD points.
Sell 1.62 GBP call (USD put) for 134 USD points.
Buy 1.66 GBP call (USD put) for 37 USD points.

A double risk reversal is shown in Fig. 7.16.

Another example, this time using the seagull in Fig. 7.14 (long 1.58 put; short 1.60 call, long 1.6365 call with underlying long GBP (short USD) at 1.60) as a base, we can use the ratio principle to buy better downside protection (at 1.59 versus 1.58) by buying just 50% of the 'top' strike (1.6365). This would be by applying the decision to give up some of the upside potential (3 in Table 7.4).

We now have a ratio seagull and the net position (including the under-

45 To the author's knowledge, there is no option strategy called a double risk reversal at the time of writing.

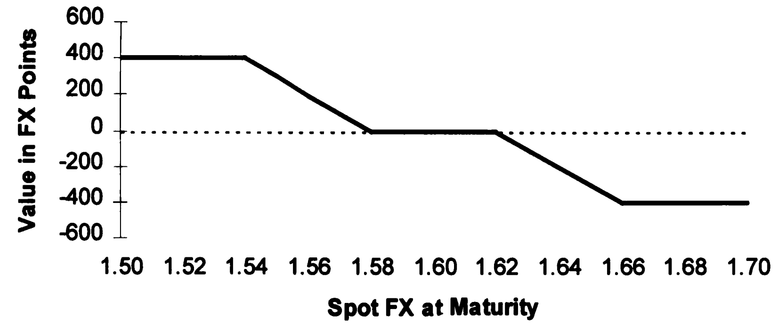
Table 7.4 A simple decision table as a first step in designing a strategy.

1	*Do you want to pay a (net) premium?*		
	Yes	Your strategy will provide benefits compared to the underlying FX rate.	
	No	You can only manipulate the underlying FX position to suit your perception of risk. No free lunch.	
2	*Do you want to eliminate all downside risk?*		
	Yes	Buy option at chosen strike in downside direction.	
	No	Buy lower ratio in downside direction/sell option at chosen strike beyond bought strike.	
3	*Are you willing to give up some of the upside potential?*		
	Yes	Sell option/buy lower ratio at chosen strike in upside direction.	
	No	Buy option at chosen strike.	
4	*What is your underlying risk price (i.e. budget rate, accounting rate, the current spot)?*		
	At market	Any premium costs will show as negative in strategy.	
	Better than market	Possible to construct no lose scenarios by incorporating current benefit into strategy.	
	Worse than market	Will increase negative margin (i.e. in addition to any premium) in strategy.	
5	*Do you want to speculate, and to what degree of risk?*		
	Yes	Buy and/or sell options to create desired profile to fit perception.	
		If right	Better (lower cost and/or more benefit) than not speculating
		If wrong	Worse (higher cost and/or less benefit) than not speculating
	No	Stick to buying options with downside risk strikes.	
6	*Does your business have an underlying bias as to the future direction of the FX rate (i.e. if unhedged, exchange losses will be compensated by extra business at the new rate)?*		
	Yes	Construct strategy with minor or limited losses in compensated direction or don't hedge at all – depending on degree of compensation.	
	No	Ignore.	

lying short GBP) can be seen in Fig. 7.17 and should be compared to Fig. 7.14.

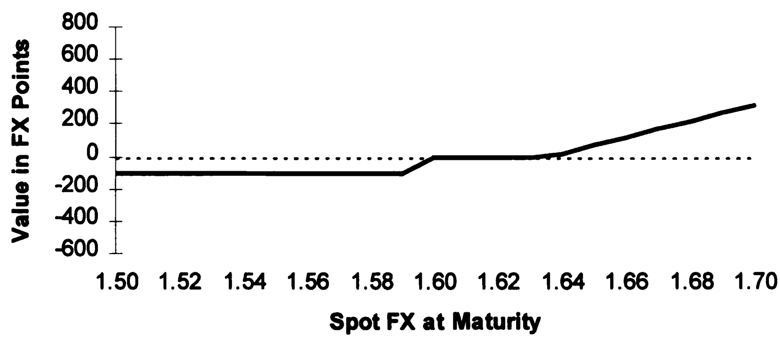
Example 2:
Buy 1.5900 GBP put (USD call) for 174 USD points - 100%.
Sell 1.6000 GBP call (USD put) for 221 USD points - 100%.
Buy 1.6365 GBP call (USD put) for 94 USD points - 50%.
Underlying position - short GBP (long USD) at 1.60.

The simple decision list in Table 7.4 is intended to be a very limited guide or a first step in the process of designing strategies to fit individual circum-



7.16 (Example 1) a double risk reversal?

A zero cost, four-strike option strategy with short FX directional risk that could be used to hedge underlying long FX position (e.g. UK importer).



7.17 Seagull with top strike 1.6365 at 50% ratio to the others.

Bought GBP call (USD put) at 1.6365 is only 50% of the sold 1.60 GBP call (USD put) and bought 1.59 GBP put (USD call). This diagram should be compared to Fig. 7.4 where strikes of 1.58: 1.60: 1.6365 are all 100%.

stances. The two examples given above can only begin to indicate the versatile aspects of combining simple (plain vanilla) options.

The next step is to compare the payout profile of the designed strategy to see if it fulfils the perceived objective. To do this one requires the facility to price the options and display this in graphical format so it is advisable to purchase an appropriate software package, such as Corporate FENICS. The minimum one could do is devise a spreadsheet and/or obtain prices from a bank, but this might prove a laborious process.

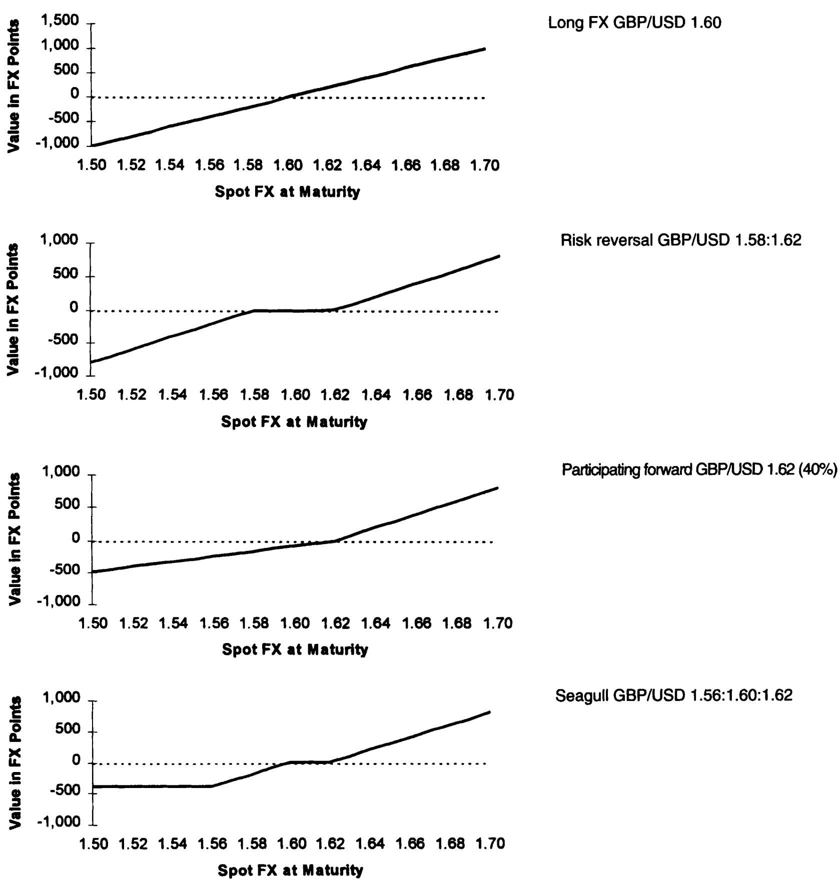
Once the facility to price and graph option strategies is in place, then the easiest way to design a strategy is simply to experiment with the different variables listed in Table 7.3 until the objective - or something close - is

achieved. In this way, the user will gain a great deal of experience and get a real feel for how options can provide excellent hedging benefits.

Risk manipulation

The term risk manipulation has been used many times in this book and is intended to describe the way in which options can be used to modify either of the two 'straight line' directional FX risk profiles (long or short).

Taking the long FX position as the example, Fig. 7.18 shows the graphic comparison of the following three strategies, all GBP/USD:



7.18 Long GBP (short USD) at 1.60 compared to risk reversal, participating forward and seagull.

1 The risk reversal - bought 1.62 call; sold 1.58 put.
2 The participating forward - bought 100% 1.62 call; sold 40% 1.62 put.
3 The seagull - bought 1.56 put; sold 1.60 put; bought 1.62 call.

With all zero cost option strategies, the best one can do is manipulate the underlying FX position as can be seen from Fig. 7.18. There cannot be a 'free lunch' or magical strategy that can give more than this. It is only by paying a net premium that one may start to achieve real benefits.

CHAPTER

8

The delta and option replication

In the preceding chapters, the option product, its characteristics and uses, how it is priced and where it is traded have all been covered. Chapter 3 showed how the purchase of a straightforward call or put could provide protection against adverse FX rate movement for the cost of the premium. History has shown that corporate hedgers have been opposed to paying premiums and zero cost strategies have been devised such as those highlighted in Chapter 7. This enabled the manipulation of the risk profile of the underlying FX position, but offered no free lunch.

All the examples, strategies and uses described so far have been based on the possible results on maturity of the option(s). But what about the interim results of hedged positions with varying changes in the underlying FX, interest and volatility rates? How does one hedge an option position?

This chapter introduces an extremely important option element - the delta - and leads to another way of hedging FX risk through option replication. The delta plays an important part in the interim valuation and performance of options but has no relevance if one only looks at the maturity values, or payout profiles, which is normally the case for the corporate hedger. However, it is important to understand the concept of delta as it also plays a significant role in the market-place and is the prime method used by banks to hedge their option portfolios.

This chapter concentrates on the option delta. Interim valuation of options and the other 'Greeks'[46] are discussed in detail in Chapter 13, risk control.

Understanding the delta

The delta of an option is usually defined as:

> The rate of change of the options value (premium) relative to a change in the underlying (foreign exchange) rate.

The delta of an option is produced as a by-product of the Black-Scholes pricing formula[47] (it is the first derivative of the model) and can also be expressed in two other ways:

1 The approximate probability of exercise at expiry.
2 The FX equivalent risk position, or hedge ratio.

The delta of an option can have a value between 0 and 1 but is usually expressed in percentage terms.

Example:
GBP call (USD put), strike of GBP/USD 1.6000, European-style for one-month maturity, premium 221 FX USD points or 2.21 US cents. (The current underlying FX rate, in this case the one-month forward, is 1.6000.)

This option is ATM in that the strike price is the same as the underlying FX rate of 1.6000. The probability of this option being in the money, and therefore warranting exercise on maturity, is 50 : 50 or an 'even money' chance - the underlying rate may go up or down from the current 1.6000 level. The delta of this option is therefore 50% which means the option price will change by 50% of the change in the FX rate - if the one-month forward rate goes up by 100 points to 1.6100, the premium will rise by 50% of 100 = 50 points to 271 points (221 + 50). This example highlights the first (usual) definition of delta.

The delta of an option changes with any factor that influences the potential exercise probability, i.e. changes in the underlying FX rate, volatility, interest

46 The option Greeks are mathematical terms attributed to various derivatives of the Black-Scholes option-pricing model. They represent option risk factors of which delta is the first derivative.

47 Reminder: Black-Scholes is the acknowledged mathematical model used as a basis to price all option products (see Chapter 6, Option pricing).

rates or even simply the passing of time. While we do not need a mathematical model to work out that the delta of ATM options is 50%, other options do require some form of calculation to be made. In the example, the effect on the option's premium of an increase in the FX rate of 100 points to 1.6100 was demonstrated. This would give the call option struck at 1.6000 an intrinsic value of 100 points, resulting in a delta that must exceed 50% - there is more probability of exercise than when ATM - and in fact the delta of this option would be about 58% with one month to elapse before maturity. Hence the delta has changed from its original 50% when FX was 1.6000 so the premium will now change by 58% of the FX rate. ***Delta is non-linear and depicts the initial rate of change only.***

Note what happens if this option is extended to one day before maturity with spot at 1.6500. Once again, the exercise probability is higher with one day to go than one month and even more so owing to the further increase in the FX rate, resulting in the delta being as high as 100%, making it mathematically certain to be exercised. The foregoing illustrates the second definition of delta - the probability of exercise.

Table 8.1 shows the delta of the 1.60 GBP call (USD put) at various levels of the underlying forward FX rate at four points in time. Initially transacted as a one-month option, the deltas are also shown with 20 days and 10 days to expiry and, finally, at maturity.

It can be seen that the ATM level of 1.60 always commands a 50% delta until maturity when the option is either exercised (if one point or more higher than 1.60) or is left to expire worthless (if one point or more below 1.60).

Figure 8.1 shows Table 8.1 in graph form. This gives the classic S-shaped delta diagram that can be found in any of the mathematical textbooks. Note that the at maturity line changes from zero to 100% at GBP/USD 1.60 and that all four time lines intersect at 50% at this rate.

Maturity exercise of the 1.60 GBP call at rates above 1.60 (100% delta) would result in a regular spot transaction at the strike rate. Once this has occurred, the option ceases to exist and the delta remains at 100%. All FX transactions have a constant delta of 100% (rate of change relative to itself!). So, unless the option is ATM, the delta will vary with time - the longer the term to maturity, the flatter the S shape of the delta profile - as can be seen from Fig. 8.1.

The volatility factor also plays an important part in calculating the delta of an option (except for ATM options, which are always 50%), in that the probabilities of change are higher when volatility is high, compared with when it is low. This is only logical. It was mentioned earlier that a call option with a delta of 100% with one day until maturity was certain to be exercised, but imagine that the volatility suddenly increased owing to, say, a possible devaluation announcement. The increase in volatility would increase the

Table 8.1 Delta (%) of a one-month GBP call (USD put) across different FX rates at varying periods to maturity.

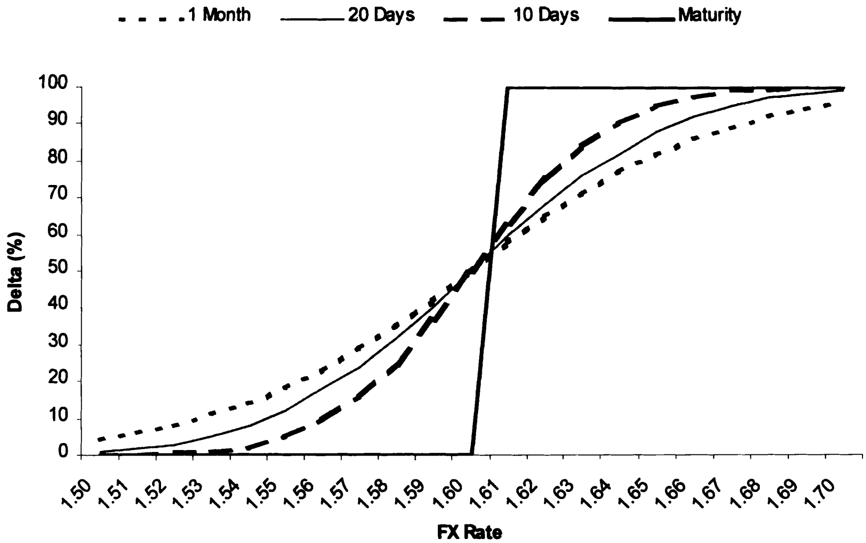
FX Rate	1 Month	20 Days	10 Days	Maturity
1.50	4	1	0	0
1.51	6	2	0	0
1.52	8	3	1	0
1.53	11	5	1	0
1.54	14	8	2	0
1.55	18	12	5	0
1.56	23	18	10	0
1.57	29	24	16	0
1.58	35	32	25	0
1.59	42	40	37	0
1.60	**50**	**50**	**50**	**0**
1.61	58	60	63	100
1.62	65	68	75	100
1.63	71	76	84	100
1.64	77	82	90	100
1.65	82	88	95	100
1.66	86	92	97	100
1.67	89	95	99	100
1.68	92	97	99	100
1.69	94	98	100	100
1.70	96	99	100	100

option's time value and, in this case, *lower* the delta of the call option as it is no longer so certain to be exercised as it was before the volatility increase. If the principle of delta is applied to the underlying FX rate we get 100% – the rate of change relative to itself. Implementing put–call parity, a direct relationship between the call delta and the put delta of any option with same strike and maturity date becomes apparent. Stated simply, this is:

(Call delta) + (Put delta) = 100%

So, if the call delta is 50%, then the put delta is also 50%. Both are ATM and the 50:50 'even money' synopsis above holds true. If the call goes to 70%, then the equivalent put option's delta will be 30% (the call being ITM, the put has to be OTM, with a lower than 50% chance of exercise). Taking the process one step further, the 100% call option will result in a zero put delta – a 'no chance' mathematical calculation of exercise probability. In theory, this zero delta put option should have no value, but try to find someone willing to sell you an option for nothing! (See Chapter 6 for details of volatility mark-up for OTM options – the Smile effect.)

It should be noted that call and put deltas would add up to 100% on European-style options only. In the case of American style, there is an addi-



8.1 Delta of a 1.60 GBP call (USD put) option at various FX levels, at three points in time.

The thick black 'nothing or 100%' line shows delta at maturity. Otherwise, the classic S shaped delta can be seen at three maturity term levels (1 month, 20 days and 10 days to expiry).

tional calculation made in an attempt to estimate the likelihood of early exercise, which may result in the two deltas exceeding 100%. As American-style options are now extremely rare in foreign exchange, we need only make a note to this effect.

> Note: The delta changes with any aspect that will change the price (premium) of an option. It is not fixed and depicts the *initial rate of change only*.

Delta hedging

It can now be seen that the delta gives us a mathematical probability of option exercise and represents the link (initially at least) between movement in FX rates and the option premium. It can therefore be used to hedge an option against any potential exercise by contracting a position in the underlying FX market; this is a delta hedge and represents the third definition for delta - the FX equivalent risk, or hedge ratio.

A delta hedge can take the form of spot or forward; the former is simply the forward delta discounted back to spot using the relevant interest rates.

Delta hedging is practised by all banks active in FX options and a spot delta hedge is conducted as part of trading options between bank counterparties (see next chapter on OTC market practice).

Another way of looking at the same thing is to say that the option delta represents the (initial) FX equivalent risk position. For example, consider a bank that sells the one-month 1.60 GBP call (USD put) from the prior example in the amount of GBP 1 000 000. The bank would receive a premium of USD 21 100 (GBP 1 000 000 × 0.0221) or GBP 13 775 (USD 21 100 at a spot rate of 1.6043) and would have a forward FX position of short GBP 500 000 (long USD 800 000) from the following:

Option position strike 1.60	Type	Underlying FX position	Delta (%)	Equivalent FX risk position
Short GBP 1 000 000	Call	Short GBP	50	Short GBP 500 000
Short USD 1 600 000	Put	Long USD	50	Long USD 800 000

So, by selling the option, the bank has assumed an equivalent FX risk position of short GBP 500 000 against USD at forward rate of 1.6000.

If the underlying FX rate moved up to 1.6100, the option would gain in value by 50% of 100 = 50 points or USD 5000 (GBP 1 000 000 × 0.0050) to USD 26 100 ($21 000 + $5000) and represent a loss to the bank of USD 5000. To hedge the short GBP 1 000 000 option position, the bank trader simply buys the delta hedge amount of GBP 500 000 (by selling USD 800 000) at 1.60 in the FX market at the time the option was sold. At the higher rate of 1.6100, the long GBP position of 500 000 will profit by USD 5000 (GBP 500 000 × 0.0100) to offset the short option loss as can be seen from the following:

Option position	Deal rate	Market price	Option P/L
Short GBP 1 000 000	221	271	loss $5000
FX position (Hedge 1)	Deal rate	Market rate	FX P/L
Long GBP 500 000	1.6000	1.6100	profit $5000

This shows the delta hedged short option position on the rise of the FX rate from 1.60 to 1.61. All very simple but why does the corporate need to know, or care, about how a bank employs the option delta for hedging? The answer is two-fold: firstly, it is not simple - the delta changes with every movement and requires constant re-hedging or adjusting - and, secondly, the principal can be used to replicate the performance of an option (i.e. without buying it). Option replication offers an alternative approach to the idea of using derivatives to cover FX risk exposure and may be a viable way for some com-

panies to operate as there is no premium transaction involved. Option replication is not, however, zero-cost.

Before explaining option replication, we need to understand further aspects that arise out of delta hedging:

The problem with delta is that it does not stand still. It is dynamic in that the numeric value changes with changes to itself so can only ever be used as an initial hedge. Picking up on the same example above, the bank trader covered the initial risk of the option sale by buying the delta hedge of GBP 500 000 at 1.6000. However, at 1.6100, the option delta is now 58% (from 50%) and the bank trader will be required to buy an additional GBP 80 000 (8% of GBP 1 000 000) at the new rate of 1.6100 in order to cover any further movement in the FX rate.

This is where a problem arises. If the trader buy the additional 8% (GBP 80 000) and the FX rate drops back to 1.60, we will face the circumstances in Table 8.2 which shows a net loss of $800.00. As the delta is now back to 50%, the bank trader will need to sell the GBP 80 000 at 1.60 (which will be the fourth transaction), realising the loss of $800.00 as a negative cash flow on the settlement date of the FX deal.

If the trader had not bothered to re-hedge at 1.6100, then there would have been no loss on the subsequent drop back to 1.6000, but any continued rise in the FX rate (say, to 1.6200) would have produced losses owing to the under hedged position (50% instead of 58%).

The FX rate direction makes no difference. The example given is of an increase from 1.60 to 1.61 but a rate decline of the same magnitude (1.60 to 1.59) would have the same effect - the bank trader would be overbought GBP 80 000 at 1.59 (where delta would be 42%) in much the same way as he was under-bought at 1.61.

The point being made here is that, no matter what happens, delta can only be an initial hedge. Any movement of the FX rate (whether up or down) or any other factor(s) that impact on the option's price, will change the delta and require an adjustment to the initial hedge.

So, the bank trader using the delta to hedge needs to make constant adjustments to the hedge amount in order to stay 'delta neutral' but, in doing

Table 8.2 Delta hedged short option position on return of FX rate to 1.6000 (from 1.600) with additional delta rehedge at 1.600.

Option position	Deal rate	Market price	Option P/L
Short GBP 1 000 000	221	221	zero
FX position (hedge 1)	Deal rate	Market rate	FX P/L
Long GBP 500 000	1.6000	1.6000	zero
FX position (hedge 2)	Deal rate	FX rate	FX P/L
Long GBP 80 000	1.6100	1.6000	loss $800.00

so, opens up the possibility of further losses. If no re-hedging is done, that also creates the possibility of losses - a Catch 22 situation.

The good news is that the option seller - the bank in this example - has received a premium and can, therefore, 'afford' to lose up to the premium amount before experiencing any real losses. In the example, the premium receipt by the bank was USD 21 100 (GBP 1 000 000 × 221 points or 0.021 = USD 21 100) so, if we deduct the first loss of $800 owing to delta re-hedging, the bank trader still has USD 20 300 and can afford to lose that amount over the remaining one-month term of the option.

Just how much more will be lost depends (for the most part) on how volatile the FX rate will be over the option term and this leads us into the basic principle of delta hedging:

Delta hedging principle

> If the option seller applies the initial delta hedge and adjusts on every change in delta, throughout the life of the option, the total losses recorded will equal the premium received, assuming the volatility experienced equals that used to calculate the premium[48] in the first place.

This principle works in reverse for the option *buyer* who applies delta hedging - the premium is paid and any re-hedging of the delta produces profits, rather than losses. Bank option traders apply delta hedging to all options, bought and sold, generally on a portfolio basis whereby every option's delta is netted and the trader re-hedges the whole on a constant basis.

One can see from the delta principle quoted above that the option seller who uses delta hedging has reduced the FX risk from one of direction to one of volatility. The option seller who is delta hedged will profit from lower volatility and will suffer from higher volatility than that implied in the option premium at inception. The option buyer is in the opposite situation and is hoping for higher, rather than lower, volatility in order to profit from the hedging. To put this another way:

> Bank traders will sell options if they believe the traded (implied) volatility is too high, and buy options if they think it is too low. At all times they remain delta neutral.

48 The traded or implied volatility.

As we already know, the professional interbank market trades options based on the anticipated volatility of the FX rate over the term of the option and conducts a simultaneous delta hedge between counterparties.

Option replication

Corporate treasurers are not normally concerned with the option delta or, for that matter, how bank traders use delta as a method to hedge their option positions. However, we can apply the principle of delta hedging to give the corporate a way of providing protection against adverse rate movement and, at the same time, give the benefit of favourable changes - the option principle - without the up-front cost of the premium.

For example, to protect against a rise in GBP against USD, one could purchase the 1.60 GBP call (USD put) for USD 22 100 that would cover GBP 1 000 000 of risk for one month. To replicate this insurance, one could buy GBP 500 000 one month forward FX at 1.60 (the initial 50% delta hedge on GBP 1 000 000) and continually re-hedge according to the 1.60 GBP call option's delta throughout the one-month term. The result would be total purchases of GBP 1 000 000 (if spot over 1.60) or zero (if under 1.60) on the maturity date.

Of course, every time the FX rate moves, rehedging will be required and losses will occur over time according to the volatility of the exchange rate. The total of the losses accrued over the one-month term will equate to a premium paid for the option. If we make the assumption that the actual volatility experienced was the same as that input to price the option in the first place, then the average rate of the purchases and sales of GBP throughout the one-month period would be 1.6221, if holding 1 000 000, or a realised loss of USD 22 100, if holding zero GBP on the final day.

Assuming also that there is an underlying transaction of short GBP (i.e. the reason for the option hedge in the first place) these pounds would be finally purchased at 1.6221 (the average rate) or at a rate below 1.6000 plus 0.0221 (the realised loss equivalent in FX terms). This is exactly the same result as if the straight 1.60 GBP call option was purchased.[49]

The advantage of replication is that there is no initial outlay of premium and any resultant loss on maturity can be lost in the final underlying trans-

49 Purchasing the option for $22 100 (rather than use replication) would entail paying the premium up-front, i.e. at the start of the one-month term, so there is an element of interest discounting that is not allowed for in this statement.

action (in the example, by averaging against the purchase of GBP at a rate below 1.60). The disadvantage is that the person replicating has the responsibility of continuously monitoring the option delta to ensure all movements are captured, 24 hours a day.

Naked hedging

Naked hedging is a naive method of hedging that only looks at the option delta position on maturity (zero or 100%) based on a simple principle:

> An option will only be needed (exercised) if, on maturity, it is in the money.

So, if the corporate wants to gain protection at a specified level (the strike of an option), no hedge is maintained when the option is out of the money and 100% is hedged when in the money, at all times through the life of the option with all transactions taking place at the chosen strike rate. Using the previous example, the corporate hedger would buy GBP 1 000 000 (sell USD) at 1.60 if the FX rate moved *up* through that level (i.e. ITM) and would sell the same amount of GBP 1 000 000, every time that it fell through 1.60 (and becomes OTM).

This method is usually employed by speculative option writers who hope to profit by the entire premium received. Options are sold as OTM and only hedged if, and when, the underlying FX rate crosses the strike price.

For the corporate, naked hedging can be successful when, firstly, the FX rate never approaches the strike and, secondly, when the FX rate goes straight through the strike (100% hedge transacted) and stays ITM without re-crossing the strike.

In the first case, the ultimate transaction (buy GBP 1 000 000 in the example) takes place at a more advantageous rate with no option premium payment and without ever doing anything - easy money! In the second case, the writer has to put the 100% hedge on as close to the strike as possible (buy GBP 1 000 000 at 1.60, in the example) and simply uses the hedge to deliver the currency required on maturity. Again, no premium is paid.

So, what is wrong with naked hedging? Well, one can be lucky with this simple approach and one does not need a computer to work out the delta hedge at any moment in time. The problem lies in applying a 100% or zero hedge at a specific rate (the strike) over the life span of the option. The FX rate can easily cross and re-cross the strike level several times and, in each case, the hedge has to be put on or taken off. The FX rate might also move too quickly to get the hedge on (or off) at the specified level, adding to the losses experienced.

The naked hedger will suffer from (at the minimum) the bid-offer spread and may even have some sleepless nights when the FX rate just 'sits'

on the strike. If unlucky, this strike/FX rate point could be crossed 20 or 30 times a day, in which case the hedger would probably suffer to such an extent that the original option premium was made to look very cheap indeed.

Don't forget naked hedging is all (100%) or nothing (zero) at the strike whereas the delta method would only be looking at minor changes such as the 50-58% in the earlier example - 8% change instead of 100%.[50]

In the very early days of FX options, a few institutions hedged in this manner but naked hedging is no longer used by professionals. A few spot FX dealers sometimes like to play naked hedging (because they are constantly trading in the underlying), but rarely for large amounts.

Note on gamma

It is difficult to explain delta without mentioning gamma. Delta is the first of the Greeks associated with options and options theory, gamma is the second. Delta expresses the rate of change of the options value (premium) relative to a change in the underlying (foreign exchange) rate. Gamma expresses the rate of change of delta for a given movement in the underlying FX rate - it is the delta of the delta!

What all this means is that the rate of delta change - gamma - is different according to various factors that influence delta. For example, if we measure gamma for a change of 100 points in the underlying FX rate, then the delta change from 50 to 58% in the earlier example represents a gamma of 8% absolute for that particular option - the one-month, 1.60 GBP call (USD put). Compare this to the same option, but with just one week to maturity (i.e. after running for three weeks or so); the delta change on the FX rate movement from 1.6000 to 1.6100 is now 50-65% - a gamma of some 15% - owing entirely to the fact that the option is closer to maturity.

Gamma is a measure of how much delta can change for a given movement in the FX rate and is usually measured against a 1% movement in such a rate (rather than by FX points). Gamma is a very valuable tool employed as a risk measure and is described in more detail in Chapter 13, Risk control.

Gamma effect on premium change

An example was given earlier in this chapter whereby the option premium changed from 221 FX points to 271 for a movement of 100 points in the FX rate (from 1.6000 to 1.6100). This demonstrated a delta of 50%. In reality, the

50 On the last day of an option's life – the maturity date – the option delta change (gamma) is the highest and can change from zero to 100% over a short range around the strike, but this can only occur on that day, not at any other time.

option premium at 1.6100 in the example would be slightly higher at around 275, which would not equate exactly to the delta hedge of 50% at 1.6000. This is due to the fact that the rate of delta change is not constant - gamma reflects this rate of change. To hedge more accurately and get close to the 275 value at 1.6100, the bank trader would need to adjust the delta at all the interim levels - 51, 52, 53, etc. In fact, the theory of delta states that the delta hedge should be adjusted on *every change in delta.* This is not always practicable and the selection of how often, or at what points in the FX rate, is a matter of choice - this is where the theory ends and the trader's skills show.

CHAPTER

9

OTC market practice

The over the counter market can be split neatly into two distinct segments: the market maker (usually a bank) and the market user (usually a corporate, or a bank acting on behalf of a customer). The market maker will be a bank dealer quoting options in terms of traded (implied) volatility with no basic interest in the direction of the FX rate over time (delta neutral). The market user can be another bank acting on behalf of a customer and may also deal in volatility in which case the bank is simply an intermediary or broker in the transaction. The more important element is the bank customer - the corporate client - who is the 'end user'. The end user's prime interest is the directional risk in the movement of the underlying FX rate - option traded volatility is usually ignored altogether.

It can be seen that there is a very big difference in the objectives of the market maker dealer at the bank and the end user - one is based on traded volatility and delta neutrality, whilst the other is volatility ignorant with FX risk to hedge. This has led to different market practices between the two and the separation of the customer from the option dealer by the bank sales desk. So we have the interbank or professional market with strict codes of conduct and uniform market practices based on volatility and delta neutrality and the bank customer based on price and FX risk.

This chapter is devoted to explaining the market practices of the interbank market through explanation and examples and then how those

practices can be used to the advantage of all but especially the end user - the corporate. We first need to understand how the market functions and the methods used to transact options from a volatility quote and this is covered below.

Volatility quoting

The OTC FX options market is efficient and has reduced option trading to the one missing component in the price - volatility. To complement this aspect, all transactions between banks are conducted on a delta-neutral basis - either delta-neutral strategies are employed (such as straddles and strangles) or a spot FX deal is agreed at the time of the volatility quote.

Banks quote in volatility terms using the Reuters Dealer System (a form of on-screen, two-way communication with hard print copy, used extensively in the foreign exchange and other markets) or through recognised OTC brokers.

Markets are made in volatility terms, quoting bid and offer rates for any particular currency, term, delta, amount, etc, but some market makers restrict themselves to particular currencies and amounts (e.g. some have a minimum of USD 20 million, others have a maximum of that amount). Certain banks specialise in particular currencies, for example, the Japanese banks are very active in JPY currency pairs but less so in other currencies. Other banks might specialise in low delta options, short date[51] options, etc. It is all a question of knowing who does what at any particular time and this knowledge can only be gained through experience as banks adapt and change stances in the market.

Unless specific details are given, a market maker will quote a two-way price (bid/offer) on the basis of a European-style ATMF (at the money forward) straddle for a given period.

Example:

Bank A calls Bank B on the Reuters Dealer System. The conversation would go something like this:

Bank A: 'HIHI FRDS. 1 MONTH EUR/USD IN EUR 20M A LEG?'

Bank B: 'HI THERE. 7.8–8.1'

In this example, Bank B, the market maker (read market maker as the person being asked to quote a price) is willing to buy an ATMF straddle at 7.8%

51 Short date options are for maturities of under one month but more specifically for under 10 days or so.

volatility or sell the same at 8.1%. In both cases, the principal amount would be EUR 20 million for the call option (one leg of a straddle) and 20 million for the put (the other leg) hence '20 m a leg'. It is interesting to note that the greeting 'HIHI FRDS' or 'HI FRDS' (hello, friends) is used extensively between market participants and is very much the norm to open conversation.

After receiving the price, Bank A has three alternatives:

1 Hit the bid at 7.8 - sell the option.
2 Take the offer at 8.1 - buy the option.
3 Decline the quote - no transaction.

In any event, Bank A will answer immediately, otherwise Bank B cannot he held to its price; it is deemed unprofessional not to respond within a few seconds unless Bank A requests confirmation of the price by stating 'any change?' or relieves Bank B of the obligation to deal by stating 'my risk'. Usually, the bank requesting a price (Bank A) will know at what level it wishes to transact before calling another bank for a price, so immediate response is usual.

Let us assume Bank A was looking to buy the straddle at 8.1 in which case the conversation might proceed as follows:

Bank A: 'AT 8.1, I BUY' (or '8.1' or 'I BUY' or 'MINE')
Bank B: 'AGREED' (or 'DONE') 'SPOT 1.1000 I SELL 20M A LEG STRADDLE, STRIKE 1.1025, 18/20OCT99' (the one-month date) 'PREM. 0.95 PC CALL, 0.95 PC PUT. PLEASE PAY EUR 380 000 TO MY ACCOUNT BANK B, FRANKFURT VALUE 20SEP99' (spot)
Bank A: 'ALL AGREED FRDS, TKS VM FOR THE DEAL, BIBI FN'
Bank B: 'TKS FOR THE CALL BIBI FN'

Any one of the statements made by Bank A from 'at 8.1, I buy' is a commitment to deal and is irrevocable from this point for both parties, unless a mutual agreement is reached not to proceed (this is extremely rare). Bank B acknowledges this acceptance and quotes the current spot rate to be used to compute the option premiums (Bank A may challenge this rate or request another) and then proceed to confirm the details of the options transacted, including the strike rate and actual expiry (18 October 1999) and the delivery date for exercise (two days after expiry or the spot date on expiry, i.e. 20 October 1999). Finally, Bank B gives instructions regarding the premium payment due to it which is paid on the current spot value date (20 September 1999). While Bank B is confirming the details, Bank A is calculating the premium amounts and strike based on the quoted spot of 1.1000, its value for the forward FX rate, and volatility of 8.1%. It confirms acceptance of Bank B's calculations and details by stating 'all agreed' or a similar

expression. The communication is ended after an exchange of thanks with another market norm - BIBI FN (goodbye for now).

Note that call and put currencies were not specified - this is because the OTC market refers to the non-USD currency as the specification in currency pairs that include the USD. This is a hangover from the days when the US exchanges formed the basis of the options markets, as both the CME and PHLX quote calls and puts in this manner. It is recommended that the currency is always quoted in order to avoid any possible confusion, e.g. EUR call, or better still EUR call (USD put), but the market does prefer to keep the narrative down to an absolute minimum.

There follows another example, but this time for a specific option rather than an ATMF forward straddle.

Example:

Bank A calls Bank B on Reuters Dealer System

Bank A: 'HIHI FRDS. ANY INTEREST TO QUOTE 1 MONTH, 130, EUR CALL - JPY PUT FOR EUR 10 MIO DELTA AROUND 12?'

Bank B: 'SURE, SEC PLS 8.5-8.9'

Bank A: 'YOURS'

Bank B: 'OK SPOT 126.4 I SEE 0.145 PC OF EUR WITH 12 DELTA USING FWD -23 ?'

Bank A: 'AGREED, SO I SELL EUR CALL AT 130.00 IN EUR 10MIO 18/20OCT99 PREM EUR 14500 TO BANK A AG, FRANKFURT 20SEP99 ON HEDGE I BUY EUR 1.2 MIO AT 126.40 20SEP99 BANK A FF FOR ME PLS WHERE FOR YOUR JPY?'

Bank B: 'MY JPY TO RAPONGI BANK, TOKYO PLS'

Bank A: 'OK WILL BE DONE TKS FOR DEAL BIFN'

This deal has a different tack. Firstly, Bank A is enquiring whether Bank B would 'be interested' in quoting the particular option. The reason for this is that this option has a very low delta and a relatively small amount and some banks would rather not have the bother of quoting for this, unless it suited them. The statement 'any interest' is standard in OTC for saying 'I know you are a professional market maker therefore I am sorry to bother you with this odd option. Only quote if you wish.' Most banks will try.

Secondly, the quote is for a specific option so Bank A gives all the pertinent details of call and put currency, strike, amount, and also an indication of the delta. Providing the delta assists Bank B in allowing the trader to adjust the volatility quote (from the ATM level) quickly. In fact, if Bank A had not stated the delta, Bank B would have asked for it. Note that it is not possible for Bank A to calculate the exact delta because the trader does not know Bank B's volatility or the spot reference rate used to ascertain the delta. Note also that both call and put currencies are defined this time, owing

to the absence of USD in the currency pair; there is no 'automatic' reference currency. Once again, no mention is made as to whether the option is European or American style as the OTC market very rarely transacts American-style options - European is quoted unless specified.

Bank B replies 'Sure, sec pls' (one second, please) which means 'I will need a few seconds to work out the volatility price owing to the unusual nature of this option, i.e. low delta'. If used in the context of normal options, 'sec pls' would probably mean 'I am very busy at the moment but please hold on'. Shortly after, the volatility price of 8.5–8.9 is set. Note that this price has a spread of 0.4, or four ticks, which is wider than the three ticks for the ATMF in the prior example. This is to allow for the illiquid nature of the specific option giving the market maker a little added protection on dealing.

Bank A responds to the quote by a simple 'yours', meaning 'this option now belongs to you' - just another short, quick way of expressing the fact that the 8.5 bid price is dealt, leaving Bank B the buyer, Bank A the seller. Bank B agrees the trade and sets the current spot as 126.40 JPY per EUR (the standard way of quoting this currency pair is EUR/JPY in the FX market). Bank B then asks if Bank A can agree to the premium of 0.145% of EUR, quoting the delta and forward points used to arrive at this amount. Bank A agrees, confirms the transaction and sets the payment instructions for the premium.

This option requires a simultaneous FX trade to neutralise the delta and Bank A confirms this part of the transaction by buying EUR 1.2 million (12% of EUR 10 million) at the quoted spot rate of 126.40. Payment instructions for receipt of the EUR are given and a request is made as to where Bank B would like to receive its JPY as counter payment. Bank B provides the name of its correspondent bank in Tokyo and Bank A acknowledges, thanks Bank B for the deal and finishes with the usual 'BIFN'.

Every deal in OTC has to be 'instructed'; i.e. payment instructions are exchanged between the parties at the time of the transaction.This is necessary owing to the absence of a centralised clearing house (unlike the exchanges) and each OTC market participant will have its own individual arrangements for processing currency payments between countries. Instructing each deal is time consuming for the trader so a few shortcuts exist. Firstly, abbreviations are used extensively like 'FF' in the previous example, meaning Frankfurt. Secondly, payment instructions can be recorded within the Reuters Dealer System, retrieved and transmitted into the conversation by inputting a code letter for each currency payment. Finally, there are local procedures in some major centres like London and New York whereby spot FX deals between banks in the centre are verified and instructed outside the dealing room by the operations or back office staff.This benefits the traders who simply state 'swap outside' on the FX portion of the option transaction. Furthermore, it also acts as verbal confirmation of the FX deal and the fact that it has been recorded in the bank's books - traders have been known to forget to write up deals!

The process of the back offices of both banks swapping instructions is becoming very efficient as more and more institutions sign up with netting agencies. Netting reduces the number of physical payments between banks dealing in foreign exchange and calls for standard settlement instructions (SSIs) for each member bank. Thus, instructing deals at the trader level, as in the above example, is reducing. In fact, banks that deal with each other on a frequent basis will have each other's SSIs, leaving the trader free of the task of typing the correspondent and account particulars - the whole process would be omitted - and the back office would complete this part of the transaction.

Interbank brokers

Most of the major FX broking houses have divisions or subsidiaries set up to cater for the OTC FX options market. In addition, there are some exclusive - FX options only - firms established with some running extended hours from one location. At the time of writing, brokers are not offering their services to non-bank institutions.

Quoting is in volatility terms with transactions taking place over direct telephone lines. Where direct lines do not exist, some institutions use the Reuters Dealer System for communication. Dial-up telephone communication should be avoided owing to the potential problems of market making without instant access to prices.

To avoid constant answering of direct telephone lines, most dealing rooms now employ the use of brokers' boxes for the relay of existing prices, requests for prices and information. These are small (but loud!) speakers located in or on the dealing desks. Bank dealers respond by speaking into the direct line telephone, if interested in a particular quote or on notification that one's own price is about to be dealt on.

Brokers provide a very valuable service in that they can form liquid two-way markets by combining the best offers and bids from a variety of sources. This is done by banks giving price support through various methods such as:

1. 'Run downs' - some banks will regularly provide brokers with full bid and offer prices for every period from one month to one year, for a particular currency pair.
2. Specific bids and offers in selected periods.
3. Bank responses to specific requests.

The rest is done by the broker who in many cases is able to convince bank traders to bid or offer at a broker's suggested level.

It is probably fair to say that, in normal markets, a broker's bid-ask spread should be tighter than that obtained on a direct basis which, of course, is paid for by the commission levied on the trading bank. Banks' attitudes vary to the role of the broker, and some institutions have reputations of being direct or brokers' banks. The leading market makers may well 'have lines' (conduct broking business) with all OTC brokers, whereas other banks may restrict these to a selected few. Over time, banks may occasionally cease dealing (line out) with specific brokers owing to transaction problems or for other reasons.

A note of warning at this point: banks pay brokers commission on every trade and this means that it is very much in the broker's interest to look after his lines, and this gives a certain amount of power to the bank trader that has to be handled on a professional basis. Many friendships are established through the broker-trader relationship, and it is incumbent on both sides that such be conducted at a very professional level. Otherwise, biased pricing on the trader's part, or unreasonable requests from the broker, may result which would not be in the best interests of either party, or the market as a whole. Codes of conduct are now laid down by most institutions as well as regulatory authorities such as the Bank of England/Financial Services Authority and the ACI Financial Markets Association (the foreign exchange association).

Returning to market practice, brokers relay prices through the boxes on a continuous basis but these are generally for specific interests or exceptional cases. Volatility rates for the regular one- to twelve-month periods (for the major currencies) are displayed on the Reuters Monitor System, Telerate or Bloomberg systems (these are information display systems and are not conversational) by many brokers.

The bank trader will usually have one or more of these pages on his screen and, by way of example, may hear over the broker box 'pay 7.95% in one-month EUR, ATM call, for 10 only'. This would be a middle of the market bid, yet for a small amount of EUR (10 000 000). Another box may shout 'looking for a price in six weeks 30 delta EUR put, up to 100 million' - here the broker is looking for a two-way price for a specific option, a 30 delta EUR put. Assuming the bank trader has no particular interest in this option, but is willing to make a market in it, he may respond '8.2–8.6 on 50, for starters', meaning that this price is not too aggressive (four ticks wide), and is for 50 million EUR only. However, the broker will be more than pleased as this quote, 8.2–8.6 provides a base to form the market for this particular option. The broker may also get from another bank trader 'I will pay 8.4 for that one, good for your amount'. The broker now has a market 8.4–8.6, 100 million by 50 million, which is quickly reflected, to the bank that asked the broker for a price in the first place. If the original request was from a bank looking to sell that option, the trader might well give the broker the following

order 'I offer 100 million at 8.5'. The broker quickly goes to the bank that bid 8.4 saying 'can offer you 100 at 8.5', to which the bank responds '8.4 best' meaning that it is not interested in increasing its bid from that level. Now the broker's market is 8.4–8.5 on 100 million.

From the perspective of the bank that made the first market, 8.2–8.6, the following would have been relayed over the broker's box:

'Pay 8.4 inside you for 100.'

'Original interest offers at 8.5; I am now 8.4–8.5 in 100 any interest or shall I take you off?'

Here the broker recognises that the original price 8.2–8.6 on 50 million has no relevance, but asks the bank trader if he wishes to do anything on the new market of 8.4–8.5; otherwise he can take him off, i.e. cancel the price.

This is just one small example of how a broker forms his markets; after all he plays no part in the final transaction and so, in theory, is prevented from making a price. However, many brokers do give their best idea of what a price should be for a particular option, but it is up to the bank trader actually to make the price. There are many games played in the market to encourage business and the brokers are usually very experienced in most of them. For example, in a quiet market with no incoming orders or requests, the broker may well invent a request and ask a trader for a market in the hope of arousing interest and, hopefully, a deal. Traders are also good at this game, claiming that customer interest is at hand and asking other banks or brokers for prices on imaginary options.

In all of the previous examples, there has been no mention of the name of the bank behind the respective prices. Counterparty names are not exchanged or given by the broker until a firm commitment to trade has been indicated. This is very different from the exchanges where it is open knowledge who is on the bid and offer. The broker carries a professional responsibility not to pass bank names on deals, except between the parties concerned, and this responsibility extends to the bank trader not to entice the broker to divulge bank names on deals other than those into which the bank has entered.

Notwithstanding the above, it occasionally happens that one bank's name may not be acceptable, for credit reasons, to the other in a transaction. In this case, both banks remain committed to deal at the agreed price in which case the broker goes 'either way' on the price. For example, if the 8.5 offer was taken for 100 million (see previous example) and one bank could not accept the other's name for the transaction, the broker's market would be 8.5 either way or 8.5 'choice', meaning the market is

both bid and offered at the same price but the transaction cannot be completed.

Normally, the broker will ask another bank to switch the transaction or do a 'put-through'[52] in which case a third bank will step in and act as counterparty to the other two. No brokerage charge is made on the third bank for this service.

To help avoid this problem, there is an unofficial grading of OTC participants with regard to their credit worthiness. This is not done by reference to the bank's balance sheet but by experience of the particular bank's profile in the market-place. Hence a broker will often qualify his or her price by suggesting that there may be a problem in concluding the deal if the volatility price is agreed. For example, 'pay 8.0% for a small name' or maybe 'pay 8.0% but might be a name you cannot do'. In the latter case, the broker may remember a prior case where his or her line had declined the bank on the present bid of 8.0%.

Spread trading

Another popular form of trading in OTC is the spread trade practised both directly and through brokers. A spread trade is the combination of two or more options with different strikes (i.e. different deltas), or different dates, or different type (i.e. calls and puts) or combinations of those factors. The straddle falls into this category but is excluded here as the usual ATM variety does not impact on the volatility price being made by the option trader – the straddle is just a very convenient way of dealing *ATM volatility* as an initial delta neutral strategy.

There are various types of spread trades but the most popular are:

1 Strangle.
2 Risk reversal (R/R).
3 Butterfly spread.
4 Call (put) spread.
5 Calendar spread.
6 Beta spread.

52 Put-through – a third party standing in between two others enables the original transaction to take place, at no cost to the third party (other than transaction costs). As such, put-throughs increase the liquidity of the market-place. However, there is a difference of opinion between banks as to whether it is correct policy to act as the third party in such circumstances on the basis of the use of credit lines to accommodate two other (maybe, competing) banks. Other banks take the view that helping banks in such cases will be compensated by reciprocal action in the future.

Strangle

A popular spread used to trade the smile of volatility.The trader buys an OTM call with a strike in one direction *and* buys the equivalent delta OTM put strike in the opposite direction (i.e. with the spot or forward FX rate in the middle), or sells both the strikes. It is usually constructed as a 25 delta (i.e. a 25 delta strangle) for both the call and put, although deltas may vary. It is initially delta neutral.

It is quoted as a bid or offer that includes a premium over the ATM volatility; for example, with ATM volatility at 7.8-8.2, a market maker might quote: 'I am 8.0-8.4 for the 25 delta strangle'. The market maker would buy the strangle at 8.0 or sell it for 8.4, both at 0.2 over the ATM volatility level. When calculating the premium, the same volatility rate is used for both the call and put options, providing the call and put deltas are similar.

Risk reversal (R/R)

A very popular spread used to trade the skew of the smile (of volatility). The trader buys (sells) an OTM call with a strike in one direction, sells (buys) the equivalent delta OTM put strike in the opposite direction (i.e. with the spot FX rate in the middle) or vice versa. It is usually constructed as a 25 delta for both the call and put. The spot FX deal is transacted for the total of the two deltas, to form delta neutrality.

It is quoted as *the difference* between the call and put volatilities with notation as to direction, e.g. 'I am 0.1-0.3, calls over,[53] for the 25 delta risk reversal'. The market maker would buy the call (and sell the put) by paying away (a debit) 0.1 in volatility, or sell the call (and buy the put) for a receipt (a credit) of 0.3 in the volatility rate. For example, assume the market maker buys the risk reversal at 0.1. Individual volatility rates might be set as (buy) call at 8.1 (sell put at 8.0) - a debit, or loss[54] of 0.1 in volatility terms. If the market maker sold the risk reversal at 0.3, then individual rates might be set as (sell) call at 8.3, (buy) put at 8.0 - a credit or profit[55] of 0.3 in volatility terms.

53 Short for 'calls over puts', meaning the price in volatility is higher for the call than for the put with a similar delta to the rate quoted. Other expressions might be 'bid for the call', 'pay for the call', etc.

54 The debit of 0.1 in volatility is not a real loss as the volatility smile and skew is a market factor and, as such, can be used to revalue the option. In fact, if mid-market rates are used – the normal practice – the trader will show a 0.1 *profit* having 'paid away' 0.1 when the mid-market rate is 0.2 for the risk reversal (in other words, the market value is 0.2 but the trader has bought the risk reversal for just 0.1).

55 As with the loss, this is not a real profit for the same reason as given in footnote 54.

Risk reversals are widely employed by corporate companies as hedging strategies (without the delta hedge)

Butterfly spread

This is a combination of the ATM straddle and the OTM strangle and is a more exact way of trading the smile of volatility. The trader either buys the ATM straddle and sells the OTM strangle, or vice versa. The OTM strangle described earlier relates the net premium, in volatility terms, over the ATM volatility rate. The purchase (or sale) of an OTM strangle still leaves the trader open to a change in the ATM rates, so it is possible for a change in the smile to be compensated by a change in the ATM volatilities. To be more exact, the trader can 'lock-in' the *difference* between the two (ATM and OTM volatilities) by trading the butterfly spread.

Initially delta neutral, the butterfly spread is quoted as the difference between the ATM volatility and the quote for the OTM strangle. For example, a market maker may quote 'flat-0.4' which is jargon for 0.0-0.4. At flat, or zero spread, the market maker will *buy* the OTM strangle and *sell* the ATM straddle. At 0.4 the market maker would *sell* the OTM strangle and *buy* the ATM straddle. On ATM volatility rates of 7.8-8.2, the volatilities used might be 8.0 for both the straddle and strangle (representing the flat bid) and 8.0 and 8.4 for the straddle and strangle respectively (representing the 0.4 offer).

Call (put) spread

This spread is used for portfolio adjustment, mostly in short-date maturities. It can be used to trade one side of the smile curve usually by transacting two OTM options (rather than ITM). The trader buys a call (put) with low strike, sells a call (put) with a higher strike, or vice versa. For delta neutrality, a spot FX deal is transacted for the net difference in the two option deltas.

Calendar spread

This spread is used to trade the volatility curve through time. Such curves can be positive (short-date rates are lower than longer-term rates), negative (short-date rates are higher than longer-term rates) or flat (short-term are similar to long-term - all rates are the same). The trader will buy options for one date, sell same strike or delta for another, or vice versa. For delta neutrality, a spot FX deal is transacted for the net difference (if any) in the two option deltas.

Calendar spreads are normally quoted by expressing one date as a

'choice'[56] price with a normal bid/offer spread on the other date. An example of a calendar spread is given below.

Beta spread

The trader buys options in one currency pair and sells in another, usually with similar deltas. Spot FX deals are transacted in each currency pair unless spread is already delta neutral (e.g. by dealing straddles in both currency pairs).

Combination spread

In addition, the market will quote for combinations of the above such as: Buy *one-month* EUR/USD 30 delta *calls*, sell *two-month* EUR/USD 30 delta *puts*. This is a calendar spread and risk reversal combined.

The object of quoting volatility as spreads, rather than individuals, is to avoid trading across two bid/offer spreads. In FX, why buy EUR (sell USD) and sell GBP (buy USD) when you can simply buy EUR and sell GBP? The same applies to options volatility trading but there are two different methods of quoting volatility spreads:

1 By netting the two individuals and closing the spread.
2 By quoting one of the individuals with normal spread and quoting 'choice' price for the other.

Example:
One-month 30 delta EUR calls are quoted 8.2–8.4; two-months 30 delta EUR puts are quoted 8.4–8.6.

Method 1:
The spread price based on these two individuals is 0.0–0.4 by simply netting the bid on one against the offer on the other, and vice versa. However, there would be no benefit from such a quote as it is identical to the two individuals so the market maker would narrow or close the quote to, say 0.1–0.3. This means that the market maker would now buy calls at 8.3; sell puts at 8.6 (net 0.3) or sell calls at 8.3, buy puts at 8.4 (net 0.1).

Method 2:
The market maker quotes the calls 8.3 choice but quotes the puts as 8.4–8.6. This is the same net result as method 1 as the market maker trades on exactly the same volatility levels, however this method is much preferred as it is

56 A choice price is one where there is no bid/offer spread. In other words, the market user may buy or sell at the same (single) rate quoted by the market maker.

simpler and has the bid/offer clearly defined. The market maker usually makes the choice price on the quote that has the lower vega[57] effect - in this example, in the one-month EUR calls. This is the normal method used between professional traders.

Exercise procedure

OTC option flexibility means final maturity can be at any reasonable time during the day but the market has adopted two main time zones and set 3.00 pm as the final point of expiry. These two cut-off times are:

1. 3.00 pm London time.
2. 3.00 pm Tokyo time.

There are other cut-off times, such as in Australia where institutions also deal for 3.00 pm Sydney time, but this is generally restricted to local transactions in the local currency.

New York has traditionally used 10.00 am New York time, which coincides with 3.00 pm London, except for a week or so each year. To avoid having two cut-off times, 3.00 pm London and 10.00 am New York, the market has moved away from 3.00 pm London by adopting the 10.00 am New York as standard.

Presumably, it is better to have traders in Europe exercising at 4.00 pm London, once a year than have the confusion and possible disagreement as to what cut-off time was originally transacted. The ICOM terms and conditions (see Chapter 14) state 10.00 am New York as the Western time zone expiry time.

OTC options have to be exercised individually, each buyer calling the seller to notify exercise and to exchange payment instructions. As in direct volatility quoting, this is usually done on the Reuters Dealer System at a time close to the final expiry; it all depends on how close the strike is to the current spot rate. Deep ITM options are usually exercised earlier in the day.

Example:
Bank B is long GBP call (USD put) with Bank A maturing 15 September in the amount of GBP 20000000, strike GBP/USD 1.6000. The current spot rate is 1.6200. On 15 September, Bank B will see from its portfolio that it has a bought GBP call option maturing that day and, with spot at 1.6200, has

57 Vega is the measure of option price (premium) movement owing to a change in traded volatility. Vega is explained in Chapter 13, Risk control.

intrinsic value of 0.0200 USD per GBP. Bank B must contact Bank A and exercise this option before 3.00 pm (10.00 am New York time) that day.
Bank B calls Bank A on the Reuters Dealer System at 2.45 pm with 'XCISE', 'EXER', or simply 'X' as a suffix against the calling code:

Bank B:	'XCISE'
	'HIHI THERE I BUY GBP 20 000 000 AT 1.60 VALUE 17TH SEPTEMBER DIRECT TO ME PLS'
Bank A:	'AGREED, SWAP OUTSIDE'
Bank B:	'OK FINE BIBI FN'

Bank B has until 3.00 pm to contact Bank A to exercise this option. The trader does so at 2.45 pm when he decides that it is now very unlikely that GBP will fall below 1.66 before that time (which would make exercise unnecessary as the trader could buy GBP cheaper in the spot FX market). Contact is made in the usual fashion except for a notation that the call is to exercise an option ('XCISE') and not to request a volatility quote. Bank B simply gives Bank A the details of the resultant spot FX deal that emanates from exercise and adds payment instructions, in this case, direct to Bank B in London. Bank A agrees to the exercise but asks that details and payment instructions be 'swapped outside' - this saves a little extra time. Bank B agrees and ends contact.

Exercise is normally a very quick procedure, which is just as well for there may be many long option maturities on any particular day - all that are ITM will have to be exercised individually by 3.00 pm. In addition, many other banks will be calling Bank B to exercise their options, i.e. Bank B's short options that are ITM. All this makes 3.00 pm London time (10.00 am New York time) a very busy period.

Occasionally, a bank may not make the 3.00 pm deadline or may even forget to exercise altogether. In these cases market practice is to 'forgive' the party concerned where the option is deep ITM. An example of this is given in the next section.

Other practices

The OTC market is made up of many different types of banks and other financial institutions, each with its own set of rules, practices and trader disciplines (or lack of them!). Nevertheless, the market operates on a very professional basis and is held together by this professionalism and the integrity of the traders.

Banks make prices to each other based on good faith and any differ-

ences are usually sorted out at the trader level by compromise. For example, when unable to agree on the premium after committing at a specific volatility level, most banks will 'meet in the middle'. Other cases of misunderstanding are usually resolved satisfactorily without recourse beyond the trading room, i.e. the courts.

For example, it occasionally happens that a bank may forget to exercise a deep ITM option, or call shortly after 3.00 pm, in which case all intrinsic value would legally be lost to the writer of the option. This would not happen in practice. The writer, knowing that he should be exercised has already structured his portfolio for such event and loses nothing by allowing the holder to exercise 'late'. In fact, many banks will call the buyer and remind him to exercise even though the 3.00 pm deadline has passed. Note that both ICOM and ISDA terms[58] allow for the facility of automatic exercise of options with intrinsic value of 1% or more, on maturity, should no notification be received. With this procedure, the writer has the choice of settling the exchange of currencies (as normal for exercise), or by cash settlement for the intrinsic value.

On the other side of the coin, it is worth mentioning the practice known as 'stuffing'. This is particularly popular with brokers (read that as 'at brokers') and comes in several forms, some are justified, others quite definitely unprofessional. Take, for example, the case whereby a broker has a market of 7.8–8.1. He relays this through the voice boxes and a bank takes the offer at 8.1. Before the broker can get back to the bank offering at that price, he hears from the potential seller (through another box) 'Off the 8.1 offer'. The broker is caught between acceptance by one line and cancellation by the other - one bank thinks he has bought at 8.1, the other thinks he has done nothing. The broker is held to finding another 8.1 offer and if this becomes impossible (owing to, say, a movement up in rates), then the broker is stuffed at that price (8.1).

In the exchange markets, brokers only act on what is being quoted in the pit and this can easily change between relaying the price to the bank on the telephone and going back to the pit with a definite order. Exchange brokers do not honour their quotes and it is accepted practice that prices can change after giving the order to buy or sell. In OTC brokers do honour their prices as a matter of pride and professionalism (and owing to a certain amount of competition).

So, having been stuffed at 8.1, the broker has a choice between asking the bank dealer to let him off the price at 8.1 - owing to the circumstances

58 Reminder: ICOM is the international currency options market; ISDA is the International Swaps and Derivatives Association. Both are used by banks and other institutions for the governing terms and conditions for FX option transactions.

this would probably be the result - or paying a difference cheque to the bank[59] for the cost against the next offer.

Another very unsavoury form of stuffing is where a price is quoted that is obviously wrong, and then someone insists on dealing on it. This is rare and tends to occur with non-professionals.

Next, a few words about reciprocity. The direct OTC market functions on the basis of banks making prices to each other on a reciprocal basis, i.e. if you call me for a price, that gives me the right to call you for a similar price. Market makers adopt this standard but some banks more so than others. There is nothing wrong in a bank stating that it wishes for a non-reciprocal relationship, providing that it is asking for quotes based on customer business, and is not running positions itself. Otherwise it would be better to use the services of a broker which do not demand reciprocation.

Corporate market

The corporate market works on a very different basis to that of the inter-bank. Access is via the sales desk of a bank and traded volatility is generally ignored - the option price or premium amount is the all-important factor. Spot delta hedge is not normally conducted and even the current spot rate is not always referenced, so focused is the corporate on the premium. This method of pricing is known as 'live' pricing and is not favoured by the bank dealer who is at risk of both spot and volatility movement, resulting in a worse quote than would otherwise be the case.

Another feature of the corporate market is that option quotes are often on a disclosed basis - the bank knows whether the corporate is buying or selling and only quotes a 'one-way' price (the bid *or* the offer). This is not the best way of doing business and gives the bank dealer an advantage that is difficult for him/her to ignore. Furthermore, a one-sided price gives no clue as to the efficiency of the quote - for example, which of the following is the best price?

1. 1.2%-1.5%.
2. Offer at 1.6%.
3. 1.45%-1.55%.

59 In London and other centres, such 'difference cheques' are normally remitted through the local foreign exchange club (the local FOREX) with a notation as to the circumstances leading to the payment.

The best price is price 3 where the bid-asked spread is the narrowest but this would not be the cheapest offer (i.e. if one was looking to buy the option) as there is a 1.5% in price 1. On the other hand, the best bid (if one was looking to sell the option) is shown in price 3 at 1.45% but what is the 'other side (bid)' of the 1.6% offer? Is it 1.5% or less?

The corporate customer usually deals with a designated sales person at the bank. One responsibility of the bank salesperson is to convert a volatility quote from the dealer into a premium price for the corporate and arrange an internal delta hedge with the bank's FX desk; this being in order to deliver a delta neutral option transaction to the option dealer, as would be the case in the professional market.

Competition between banks for corporate and other end-user business is very strong and companies have not been slow to recognise this fact and have been able to play one bank against another to get the best possible premium quote. Whilst there is nothing wrong with healthy competition, the method of comparison should be made in volatility terms with a spot reference. This would be better for both parties as it gives a true reflection of the best value being offered between banks. This is discussed in the next section.

How to compare quotes using volatility

There are two basic ways to compare option prices in a more efficient manner. The first is a simple extension of the current 'live' price request and the other involves the use of option pricing software. It all depends on individual circumstances and to what extent the corporate wishes to emulate the professional interbank market.

Live pricing method

If the corporate customer has no access to option pricing software (such as Corporate FENICS), price comparison can still be made more efficient whilst maintaining the present method of live pricing.

Example:
A corporate is looking to *buy* a 1.60 GBP call (USD put) for one month:

Ask (bank) for:	Reason	Response
Indicative price	If 'indicative' there is no pressure on dealer	Bank sells at 1.26½% of £
Spot reference	Affects comparative pricing	1.6002
Volatility used	Affects comparative pricing	11.6%
Delta	Indicates price change owing to spot movement	46%

The corporate is now armed with some valuable information to compare prices for the same or similar options. The next step is to call another bank or banks and request the specified option in the following manner: 'At what volatility would you sell a 1.60 GBP call, USD put for one month in GBP (amount)? Option is a 46% delta on spot of 1.6002.'

Any answer below 11.6% will be the cheapest purchase in terms of value as the price will compute to below the 1.26½ from the first quote. The actual premium will depend on the level of spot when the option is dealt but, as we have the delta, this can be calculated from 1.6002, given small movements in spot. For example, if spot is 1.6012 when option is transacted, this will equate to a premium of approximately 1.29½% from:

> Spot movement = 0.0010 (1.6012–1.6002); delta = 46% so increase in price of \$0.00046 which is £0.02873% (0.00046/1.6012 × 100)
>
> Original price of £1.265% + £0.02873% = £1.2937%

This method has reduced the quotation to volatility which is what the option dealer at the bank is interested in. Furthermore the corporate has also provided the delta which saves even more time, resulting in a very fast return of price from the dealer. The comparison is far more accurate because the initial spot movement has been taken out of the equation. Under the old method the corporate would be comparing option prices based on different spot rates which do not indicate the best value being offered in volatility terms – the market dealing medium.

An extension of this method would be to ask for *two-way* prices – bid and offer – rather than disclose whether one is buying or selling. Once again, the volatility rate is the all important factor and two-way pricing will hold the additional advantage of showing which bank is providing the best overall price in terms of spread (difference between bid and offer rates). Using two-way pricing will also open up the opportunity for the corporate to arbitrage between banks if the occasion arose whereby one bank's bid was higher than another's offer (in volatility terms).

Note that the corporate is open to risk of spot rate change whilst comparing volatility quotations from different banks. As the intent is to obtain

the best (lowest, if buying) price the corporate could remove the spot risk by transacting a delta hedge before starting the volatility comparisons. For example, on the first call, the corporate could buy 46% of the option GBP face amount (corporate is short GBP underlying so needs to buy GBP) with that bank at 1.6002 and then unwind this as a delta hedge with whichever bank offers the lowest volatility quote. Any loss on premium because of adverse spot movement will be made up from profit on the delta hedge, and vice versa. This is very professional and is welcomed by the banks which will translate it into better prices.

Using option pricing software

The use of pricing software extends pricing comparison to match that being used by the banks.

Example:
A corporate is looking to ***buy*** a 1.60 GBP call (USD put) for one month:

Ask (bank) for:	Reason	Response
Indicative volatility level for option	If 'indicative' there is no pressure on dealer	Bank sells at 11.6%
Current spot rate	May affect volatility quote	98–02 (1.5998–1.6002)

Very little information is required from the bank. In fact, the current spot rate could be obtained from the Internet or other information carriers - the volatility quote being the one factor required to price the option.

Using the software, the corporate calculates the premium of the option using the correct 'side' of the spot rate - 1.6002 (buy GBP call = underlying long GBP = buy GBP at spot offered rate). Alternatively, enter the spot spread price into the software and use the offered (highest) side of the premium quote.

Assuming the resultant premium of 1.26½% is an acceptable price to pay for the option, the corporate notes the consequent delta of 46% and proceeds to compare the volatility quote with other banks using the following, or similar, phase: 'At what volatility would you sell a 1.60 GBP call, USD put for one month in GBP (amount)? Option is a 46% delta on spot of 1.6002.'

The lowest volatility offer below 11.6% will give the cheapest relative premium notwithstanding a change in the spot rate.

As with the live price method, the corporate could protect against spot movement by transacting the delta hedge as the first action - for example,

when spot is at an acceptable level - by *buying* 46% of the option face value in the spot market. This hedge would be unwound with the bank offering the lowest volatility quote as part of the option transaction. In this case, the corporate would re-phase the bank request to: 'At what volatility would you sell a 46% delta, 1.60 GBP call, USD put for one month in GBP (amount) with delta hedge?'

If we extended this method to asking for a *two-way* price - bid and offer - rather than disclose whether one is buying or selling, we will have reached a level of dealing that is consistent with that in the professional inter-bank market. Using two-way pricing will also open up the opportunity for the corporate to arbitrage between banks if the occasion arose whereby one bank's bid was higher than another's offer (in volatility terms).

CHAPTER

10

Bank relationships

Bank relationships and good pricing go hand-in-hand. This chapter attempts to explain the roles and responsibilities of the salesperson and bank dealer and the professional conduct expected of them. In this way, corporate customers may better understand what drives the bank staff and how best to manage the relationship. Some basic guidelines are given to encourage the corporate to adopt professional and proper ways of dealing in FX options that can only serve to enhance any bank relationship.

The salesperson

There are two types of salesperson - those who are FX option dedicated and those who sell other financial products, in addition to FX options. It all depends on the bank concerned and the dealing room structure. In both cases, the salesperson's prime role is to act as an intermediary between the corporate and the option dealer for the pricing of option transactions - let us call this Sales. Additionally, the salesperson is usually responsible for the marketing of the product(s) to prospective clients - this we can call Marketing - which may also include offering advice on suitable strategies or the promotion of specific options (usually of the exotic variety).

As with all intermediaries, the salesperson has a dual role: firstly, to look after the corporate client's interests and to promote further business and, secondly, to present option business to the bank dealer in volatility terms as a delta neutral transaction. This dual role opens up a potential conflict of interest - a better price from the dealer will increase the probability of dealing with the corporate but, at the same time, will reduce the potential profit to the dealer and the bank. Bear in mind that it is the bank that pays the salesperson's salary and bonus. This means the salesperson's job is suited to someone who can manage the contradictory aspect of the role - someone who is good at selling and is part diplomat with a personality to match. The bank salesperson is very often female and has an academic background.

Motivation

The salesperson may report to the FX options chief dealer or (more likely) the FX options manager if operating as a dedicated options salesperson. If non-dedicated, the salesperson may report to the FX manager or to a general sales and marketing manager. The important point with regard to motivation is where the salesperson's bonus pool is located - this may, or may not, be the same as the FX option dealer's - and this varies between banks.

The salesperson is motivated firstly, through financial reward of salary and bonus and, secondly, by non-financial factors. Non-financial rewards usually take the form of recognition from other areas of the bank where the option salesperson may have secondary relationships, for example, with the account manager or loan officer responsible for the overall corporate relationship. Performance is measured in various ways but will usually include one or more of the following:

Term	Method	Example	Who pays
Sales credits or 'add-ons'	Mark-up of dealer's price to corporate	Dealer offers at $1.26^1/_2$%, salesperson adds $^1/_2$%, quotes 1.27% to corporate	Corporate (not advised)
Volume credits	Fixed payment per deal	$10 per million	Dealer/bank
Transaction value	Revaluation profit (mid-market)	Dealer's price $1.22^1/_2$–$1.26^1/_2$, corporate buys at $1.26^1/_2$%, option valued at $1.24^1/_2$%, being mid-market	Dealer/bank
Promotional credit	Fixed payment per 'special' deal	$100 per million of sales of XYZ option (exotic)	Dealer/bank

Soft credit	Recognition of relationship value	Corporate does new (other) business with bank	Non-financial
Soft credit	Recognition of relationship value	Corporate speaks well of bank to other corporate(s)	Non-financial

Although financial reward is the ultimate objective, the bank salesperson will very often enter into transactions with corporate clients without any of the above 'credits' in order to win in face of competition or instruction from other areas of the bank (e.g. account manager).

On the other hand, there will be some occasions when the bank salesperson will not conclude a transaction without some form of credit for, in the end, both individual performance measurement and subsequent bonus will depend on the total credits over a specified time period.

Job pressures

The salesperson, unlike the dealer, has no risk positions to worry about and can sleep soundly at night. Job pressure arises from trying to meet corporate premium requirements against the interests of the dealer and the salesperson's deal credits. In addition, pressure to win business often comes from other areas of the bank (such as the loan officer) where complaints are registered by the corporate should the bank have been non-competitive on option pricing in the eyes of the customer.

On one side (the relationship with the option dealers), the salesperson has to operate in the same professional manner as though he or she were a dealer at another bank. On the other side (the relationship with corporate clients), the salesperson has to (in some cases) all but abandon the ethics employed with the dealers as corporate customers pressure for premium value. This can lead to frustration and bitterness between all parties. Guidelines for proper corporate dealing are given later in this chapter.

The dealer

The option dealer operates under a completely different set of circumstances compared to the salesperson. Firstly, the prime responsibility is to keep the various currency portfolios - there may be 50 or more different currency pairs - within set risk limits whilst, at the same time, managing for profit expectations. Unlike the FX dealer, the option counterpart has multiple facet risk to manage (the option Greeks).

Next comes dealing - making and asking prices of other banks - and this is where the major impact is made on the dealers' profit expectations. In fact, many banks would be more than happy to retain the initial booked

profit - the transaction value[60] - and disregard trying to make profits from positioning in gamma, vega and the rest.

When dealing through an option broker or with another bank in the market-place, everybody is working to the same code of conduct. This means that quotes and deals can be made very quickly and decisions on whether to deal or not are made within a few seconds with no haggling. Dealing with the sales desk doesn't work like this and consequently the option dealer is more attuned to dealing with the market than with his own bank (i.e. the sales desk) which may lead to less attractive pricing than would otherwise be the case.

Motivation

The option dealer is profit driven. Annual targets (budgets) will have been set against which the dealer's performance is measured for bonus payments. Outside this one consideration, little else matters. Corporate business for the option dealer is important in that this can provide core profits through the dealer's bid/offer spread, over time. Furthermore, corporate use of options is normally to hedge against FX risk and is therefore end-user business - there is no other motive (such as perceiving volatility rate movement) in the transaction, leaving the dealer with valuable trading opportunities against market and other banks' prices.

Pressure is usually applied by the options manager on the dealers to make better prices to corporate clients than to the market generally.

Job pressures

The option dealer's job pressure arises from:

Action	**Risk**
Making prices (interbank)	Buying too high, selling too low
Making prices (corporate)	Dealing without adequate price spread Losing deal to competition
Making prices (several at once)	Error Market movement whilst prices open

60 Transaction value or TV is the profit margin achieved when the deal is booked in the bank's accounting system. As all transactions are marked to market (revalued) at mid-market, all sales above and all purchases below the mid-market rate will produce revaluation profits.

Managing risk (office hours)	Losing money from adverse movements in one or more of the Greeks
Managing risk (outside hours)	Losing money from adverse movements in one or more of the Greeks 'On call', 24 hours a day Controlling overseas staff

These pressures are very different from the salesperson who has no worries about market risks once a transaction has been concluded.

Is price all that matters?

A good bank relationship will not be dependent entirely on price. What constitutes a good relationship will vary according to the needs of the corporate in question and the degree of service being offered. The large service banks will provide a very wide range of option services, from pricing, right the way through to option portfolio revaluation. Such service may include the provision of software, advice on suitable strategies, rate forecasts, daily market reports, new strategies and other 'free' aids.

Outside what is being offered, the corporate should look at the bank's reputation in the following areas:

Pricing	Consistently good when compared in volatility terms to other banks
Confirmations	Clear and promptly dispatched by electronic means (email or fax)
Information	Up to date information on rates, volatilities and strategies being used by other corporate clients
Terms and conditions	Use of either ICOM or ISDA
Settlements	Efficient back office
Credit lines	Facilities to deal without margins
Position statement	Ability to provide client with current risk exposure and portfolio revaluation

The above should apply to all banks, regardless of size and options commitment.

Guidelines for good relationships

The basis of a good relationship has to be understanding and respect. Lack of product knowledge and professional market practice on the corporate

side should not be a deterrent to a good relationship as it is part of the bank salesperson's responsibility to educate and advise his/her clients on all aspects of options and offer suitable products to meet the corporate requirements.

For example, one of the worst problems experienced by bank staff is the comparison of price (by the corporate) without reference to either spot or volatility - this practice accounts for more problems and misunderstandings than any other. Chapter 9 explained how to compare bank pricing using more efficient methods.

Table 10.1 gives a list of guidelines for corporate users of options to help foster good relationships with banks. Many of the guidelines given are centred on professional conduct evident in the interbank market and supported by the London Code of Conduct issued by the FSA (previously by the Bank of England).

Table 10.1 Guidelines and results.

Guideline	**Result**
Always compare pricing with spot and volatility referenced	Accurate comparison of value
Where possible, always avoid dealing on live prices	Better pricing
Where live pricing is unavoidable, always ask bank for 'any change' before committing to deal. Do not keep bank on hold and expect price to remain unchanged	Professional conduct
Where possible, do not indicate whether one is a buyer or seller	Two-way price (bid and offer) shows dealer's spread
Give indication of size of transaction to dealer and whether it is one's full amount	Dealer can offer better prices with full information
If possible, indicate delta. If not available, ask salesperson to calculate for you	Faster pricing
Do not divulge the bank names being used for comparative pricing	Confidentiality and professional conduct
Do not invent better prices from imaginary banks as method of bartering	Professional conduct
Do not ask bank to deal on off-market spot prices, even if delta hedged	Professional conduct
Do not hold bank to deal on obviously wrong prices	Professional conduct
Where possible, always conform to market conventions (amounts, terms, cut-off times, exercise procedures, etc)	Better pricing and professional conduct
Do listen to advice being offered by bank	Better pricing

The corporate option trader should adopt this code of conduct which sets out the general standards and controls required covering foreign exchange (including options), deposits, bullion and other products and gives a statement of best practice in dealing principles and procedures. The Association of Corporate Treasurers commends this code to its members. It also acts as a principal as to best practice in the markets to which the members should adhere. The London Code of Conduct can be found on the FSA's website. See Appendix II for details.

CHAPTER

11

Using options for hedging: intermediate

Chapter 7 detailed most of the basic option strategies that are currently used for hedging. Despite having fanciful names such as seagulls, such strategies comprise nothing more than plain vanilla[61] options. This chapter takes the first step beyond the plain vanilla and enters the world of exotic options - those options that have payoffs and features that cannot be constructed through vanilla options (although vanilla options may well be constructed through exotics). Exotic options are hybrids of vanilla options.

The definition of an exotic option is simply:

> Any option that is *not* a regular plain European or American-style option.

Note: The term 'exotic' is often used in the context of emerging market *currencies* such as Thai bahts, Indonesian rupiahs, Malaysian ringgits, etc. Thus, a bank active in exotics may be referring to foreign exchange in unusual currencies and not the option product. It is, of course, possible to have exotic options on exotic currencies.

61 Reminder: plain vanilla options are European- or American-style options on foreign exchange being any one of, or combination of, the four basic option strategies: bought call, bought put, sold call, sold put.

This chapter concentrates on those exotic options used for hedging that have been around for some years - the 'traditional' exotics - and the next chapter looks at more recent developments.

If the option is considered to be the first derivative (of the underlying FX market), then exotics are the next level up - derivatives of options. The first of the exotics listed in this chapter is a perfect example - the compound option is an option on an option!

Compound options

The underlying instrument for a normal currency option is the exchange rate between two currencies, e.g. a EUR call, GBP put option would allow the holder to buy EUR and sell GBP at the strike price. With a compound option, however, the underlying instrument is itself a currency option so it is an option on an option!

The buyer of a compound call option has the right to buy the underlying option at a fixed premium on a fixed date in the future. Likewise, the buyer of a compound put option has the right to sell the underlying option for a fixed premium on a fixed date in the future. In either case, the buyer of the compound option will be required to pay a premium for this right in the same manner as for plain options. This means there are two premiums involved in the transaction: the first, to buy the compound, and the second, the underlying option premium, which was agreed at the outset. The second is therefore the compound option's strike.

Example:
Underlying option - EUR put / GBP call, strike of EUR/GBP 0.70, six-month expiry, EUR 1 000 000 premium 200 GBP points.

The buyer of a one-month compound call option with strike of 200 GBP points would have the right, but not the obligation, to purchase the underlying six-month EUR put (GBP call) in one month's time for GBP 200 per EUR. For this right, the buyer would pay a compound option premium of, say, 40 GBP points (GBP 4000).

The buyer would only exercise the compound call option if the underlying EUR put (GBP call) struck at EUR/GBP 0.70 would be worth *more than* 200 GBP points on expiry of the compound after one month. If exercised, the buyer would then pay the second premium of 0.0200 (200 GBP points) per EUR (GBP 20 000, in this case).

The buyer of a compound put option would have the right to sell the underlying option and would therefore only exercise if the underlying option, struck at EUR/GBP 0.70, would be worth *less than* 200 GBP points on expiry of the compound after one month. If exercised, the compound buyer would *receive* the premium of 0.0200 (200 GBP points) per EUR - GBP 20 000.

Uses for compound options

The most common use of compound options is to be found in the cases of tender-to-contract situations. Consider a UK exporter tendering in EUR to supply equipment to a German buyer. The UK exporter is bound to hold its price firm for the period of the tender and is therefore at risk from changes in the EUR/GBP exchange rate during that time. The company will not want to cover this risk in the forward FX market as the contract may not be won and there would be no FX risk. For the same reason, a normal EUR put (GBP call) option will look rather expensive.

A compound option could be purchased for the period of the tender which would cover this contingent risk. If the contract is won, the underlying option could be exercised (if ITM at that point because, if not, the exporter could purchase the same underlying option cheaper in the marketplace). If the contract is lost, a considerably smaller premium has been paid (for the compound) than if a normal option had been purchased. Of course, even if the tender was unsuccessful, the compound may still have intrinsic value on expiry, in which case the exporter would simply exercise the compound and sell the underlying option to gain this value, reducing the overall cost of the hedge.

Example:
A UK exporter tenders to supply equipment to a German buyer. The result of the tender will be known one month from now. If the tender is successful, the equipment will be dispatched with payment of EUR 1 000 000 due six months from tender result date.

An exporter buys a one-month compound call option on a six-month EUR 1 000 000 put (GBP call) struck at EUR/GBP 0.7000, premium 200 GBP points. The compound strike is 200 GBP points, the compound premium is 40 GBP points.

The possible results on the tender result date in one month are as follows:

Tender	Price of underlying option	Action taken	Total cost
Won	Higher than 200 GBP points	Exercise compound	240 GBP points
Won	Lower than 200 GBP points	Buy underlying option in market	<240 (40 + market price)
Lost	Lower than 200 GBP points	Compound expires worthless	40 GBP points
Lost	Higher than 200 GBP points	Exercise compound and sell underlying option in market	<40 points (40 − intrinsic value)

One can see that the compound premium of just 40 GBP points or £4000 for the EUR 1 000 000 option is a very small price to pay to guarantee the cost of the underlying option for the one-month tender period. The maximum possible cost of both the compound and the underlying (the first tender listed in the example) is 240 GBP points or £24 000 to cover the entire transaction and guarantee a worst possible ultimate exchange rate of 0.70 (at expiry of the underlying vanilla option). It is also interesting to note that there is a possible return even if the tender is lost - it is feasible that the underlying six-month option would have a value higher than 240 after one month, resulting in a profit to the exporter.

As with normal options, the strike price of the compound is chosen by the buyer and this may be in, at or out of the money. Using the previous example, the strike price of the compound will depend on how much the buyer wants to pay for the underlying six-month EUR put (GBP) struck at EUR/GBP 0.70. The present value of this option is 200 GBP points, therefore a compound call option with a strike of 200 GBP points is at the money. Let us assume the compound call option premium for this strike is 40 GBP points, as in the example.

What if the buyer was to choose a compound call option strike of, say, 250 GBP points? Here the compound buyer would be willing to pay 250 points for the underlying EUR put (GBP call) which is more than the current value of 200, so the compound option is OTM, i.e. the underlying option is not worth exercising at 250 when it can be bought for 200. Consequently, the compound call option premium *will be less* than that struck ATM, let's say, 20 GBP points (GBP 2000 on EUR 1 000 000).

Using the same logic, a compound call option with a strike of 150 GBP points will be ITM as the underlying option is currently worth 200, i.e. the compound is worth exercising as it has an intrinsic value of 50 points. The compound premium of this option might be 70 GBP points.

So, the more the buyer pays for the compound option, the less he pays for the underlying, and vice versa. However, the absolute cost of the hedge, if the compound is exercised, is always the total of the two premiums - one for the compound and one for the underlying - and this total is a function of the strike price of the compound. Using the examples given, it can be seen that the cheapest is the purchase of the ITM compound (70 + 150 = 220 GBP points), the most expensive is the purchase of the OTM compound at 270 GBP points (20 + 250), with the ATM falling between these at 240 GBP points (40 + 200).

Stated simply, the more one pays for the compound, the less one pays later and the cheaper the absolute cost (assuming exercise of the compound). So the buyer's determinant of the compound strike is the likelihood of winning the tender. If a high probability, one will pay more for the compound (and less overall), while if the probability is low, one will pay less for the compound, which will be the only cost (unsuccessful tender, no need for underlying option, no exercise, no second premium).

Compound options are quoted extensively in foreign exchange, but actual transactions are few in numbers.

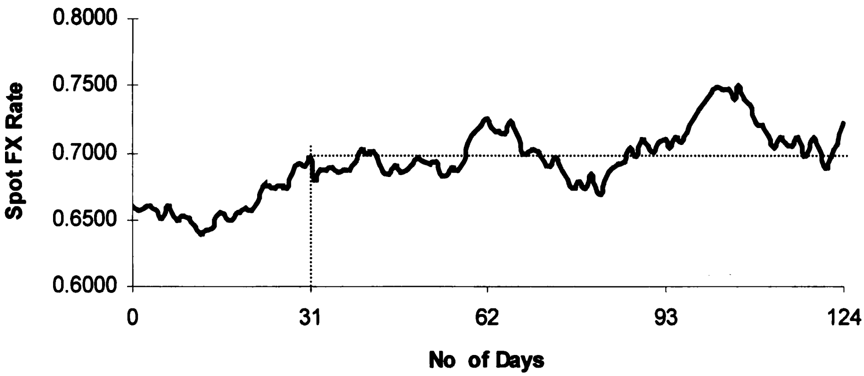
Forward start options

The forward start (or the delayed or deferred start) option is a standard call or put option that begins life after the elapse of a specified time. The buyer receives an option with strike set ATM at the time of the option creation rather than at the transaction date. For example, a company may buy a three-month EUR put (GBP call) to start one month later. The premium is paid immediately but in one month the buyer receives a three-month option with strike set at whatever the ATM rate is at that time.

Figure 11.1 shows such an example with spot rising from an initial EUR/GBP 0.6600 to 0.7000 after one month; where strike is set at 0.7000 for the three-month plain vanilla option. While those normally transacted are ATM options, it is possible to arrange for option strikes that are proportionally ITM or OTM on the forward creation date; for example, 1% OTM.

Forward start options carry only vega risk (see footnote 57 on page 125) from the transaction date until the forward creation, or strike setting, date. After strike has been set, the option is, of course, a normal plain vanilla until maturity.

Forward start options can be useful where a buyer feels the current value of an ATM option is good (i.e. the traded volatility level is favourable) but does not have a need for such an option until a specific time in the



11.1 One-month forward start ATM, EUR put (GBP call) three months, spot at inception 0.6600, ultimate strike - 0.7000.

future. As such, forward start options are sometimes used as part of a structured transaction[62] and are seen occasionally in the market-place.

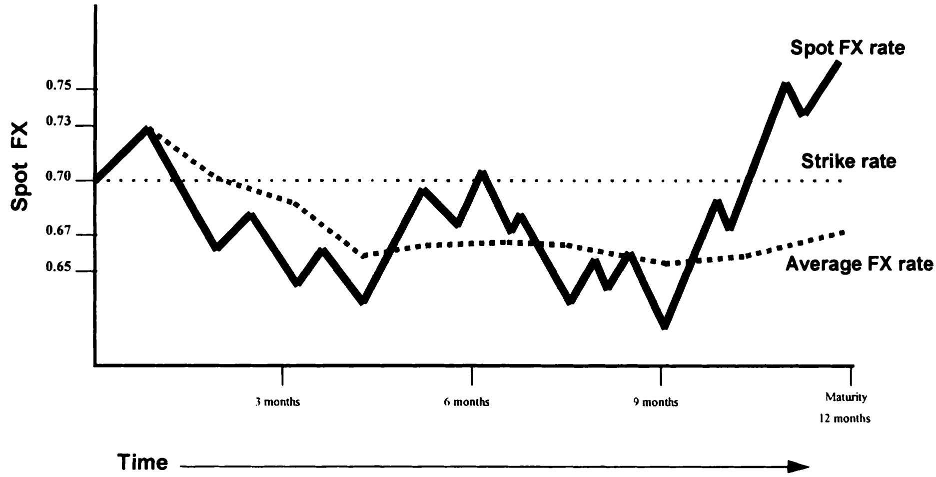
Average rate options (AVROs)

Sometimes referred to as Asian options, average rate options are one of a series of 'true hedging instruments'. They compare to regular FX options in that the buyer is protected against adverse movements in FX rates, while benefiting from favourable movements. The big difference is in the fact that the intrinsic value on maturity of an average rate option is based on the comparison between the strike and the average FX rate over the life of the option, not the spot rate on maturity.

FX rate fixings are taken at predetermined, regular intervals from an agreed source in order to produce an average rate for the period. Owing to the averaging process, the volatility of such rates is much less than that of regular spot rates, thereby producing a lower premium than for normal options. This factor is the major reason for the popularity of average rate options.

The example in Fig. 11.2 shows a fairly volatile spot over the 12 months of the option's life but the averaging process smooths out the volatility to

62 A structured transaction is usually a combination of different types of options, or of options and other instruments that do not have a specific designation (name). They are normally constructed to meet specific customer requirements, often across more than one underlying market.



11.2 Average rate option, 12 months tenure, strike EUR/GBP 0.7000 (being ATM at inception).

the point where there is a large difference at expiry - so much so that the strike of EUR/GBP 0.7000 is OTM for an average rate call option but ITM for the put, the reverse of a EUR/GBP 0.7000 plain vanilla European-style option. This effect is due to the sharp appreciation in the spot rate over the last three months, rising to over 0.7500, which has only a moderate effect on the average rate, which comes in at 0.6725.

Cash settlement

Another difference with average rate options is that they are cash settled, i.e. the intrinsic value on maturity (if any) is paid by the writer to the buyer of the option as a cash sum. This is because it is not possible to gain the intrinsic value through exercise at the strike price. Normal options are exercised on maturity to produce a spot FX transaction at the strike rate; this can be easily realised into cash by reversing the spot deal in the market at the prevailing rate. To do the same for an average rate option would require the ability to trade in the spot market at the historical average rate, which clearly is not possible.

Rate fixings

Fixings can be taken daily, weekly, or monthly, but the interval between fixings should be constant. The source of such fixing has to be agreed between the counterparties and is generally a third party reference accord-

ing to the currency pair involved; examples include the daily British Bankers' Association (BBA) fixing for GBP, the European Central Bank fixing for the euro or, in the absence of an official fix, the published rate on Reuters or Telerate at a specified time (e.g. 11.00 am London).

Uses for average rate options

Average rate options are the perfect hedging tool for companies who have FX exposure in the form of regular cash flows in known amounts. This is especially relevant where the company uses an average rate for annual accounting or budget purposes.

Example:
A UK exporter has a regular cash inflow of USD 1 million per month on the 15th of each month for a year. The profit for the year has been assessed using the current GBP/USD exchange rate, leaving the company at risk to the decline in the value of the USD against the GBP (a rise in the value of the pound).

To hedge this position the company could:

1 Buy regular GBP call (USD put) options in the amount of USD 1 million for each of the 12 periods struck at the current GBP/USD rate. Total cost of premiums - GBP 225 000.
2 Buy a one year average rate GBP call (USD put) option, struck at the current GBP/USD rate for USD 12 million. Cost of the one premium - GBP 150 000.

There is a cost saving to the company of GBP 75 000 between choices 1 and 2, but it is worth looking at what would happen in each case. Assume the current GBP/USD rate is 1.60 and this is the chosen strike rate in both cases:

1 Each month would, in turn, involve the company selling USD 1 million on the 15th, either through option exercise (if the spot rate was higher than 1.60) or at the prevailing spot rate (if lower than 1.60). The net effect is a worst case scenario of selling the USD (and buying GBP) at 1.60.
2 With the average rate option, the company sells the USD 1 million and buys GBP on the 15th of each month at whatever rate is prevailing in the spot market at that time. After 12 months the company will have sold 12 million USD in the spot market. These sales will take place at the same time of day as the fixing for the average rate option in order that the average, when calculated after the 12-month period (i.e. for the average rate option), is very close to that obtained by the company in the spot market.

Now assume the calculated average turns out to be GBP/USD 1.65 over the 12 months. This rate is higher than the average rate option strike of 1.60, so the company receives a cash payment for the GBP call (USD put) as settlement of the average rate option.

This amount is GBP 227 273 from:

(USD 12 000 000/1.60) – (USD 12 000 000/1.65)

In the first case, the company never buys GBP (sells USD) above 1.60 and may buy GBP at below 1.60 on occasions when the monthly receipts of USD coincide with a spot rate at such a level. In the second case, the company always buys GBP (sells USD) at the prevailing spot rate each month, which may be above or below 1.60, but ultimately achieves an average of 1.65 (indicating that many of the sales were above 1.60). In this case, the company is compensated back to the strike rate of 1.60 by the payment of GBP 227 273 as cash settlement of the average rate option.

In effect, the two strategies have much the same outcome. The worst case is buying GBP and selling USD at 1.60 and, if the average is lower than 1.60, then the company would have bought GBP over the life of the option at that lower rate (but, of course, with no cash settlement from the average rate).

The main difference is in the premiums paid. In this example, the average rate is cheaper by GBP 75 000 being about 33% cheaper than the 12 individual options. Average rate options will always be cheaper than a strip of individual (regular) options and a 30% saving is fairly typical.

Despite the apparent cheapness, the buyer of an AVRO does concede a potential benefit that is not always evident (and may not apply) but does warrant comment. Note again the earlier example: in choice 1 the company always buys GBP and sells USD 1 million at a maximum rate of 1.60 through the option exercise (if the spot is higher than that level) and, indeed, the average (on the AVRO) was above 1.60 at 1.65. Nevertheless, it is possible to achieve an average rate of 1.65 where certain points in the averaging are below 1.60, in which case the company under choice 1 would benefit from the difference on USD 1 million for the amount under 1.60 (the AVRO strike) each time it occurred during the 12-month period. Obviously this benefit has to be limited otherwise the average would not be above 1.60.

AVROs are popular not only because of the lower premium but also because they fit the requirements of the budget or the accounting practices adopted by many companies.

Effects of averaging

It is worth commenting on some of the effects of the averaging process. The delta of an AVRO behaves in a different way to that of an ordinary option in that it will always approach zero at expiry. This is due to the averaging effect

on the underlying rate and the fact that the option is cash settled. For example, consider an average rate option with weekly fixings over two years (104 points to produce the average) that has one week left before expiry. Since the last 103 rates are already known, the last fixing will have very little effect on the overall average and, therefore, on the option price (premium). Thus we can see that, as more and more fixings are taken, the less sensitive the price becomes to the spot FX rate, and with this process the sensitivity of the delta itself (the gamma) reduces. As a result, most of the risk in an AVRO is in the early stages. This is the opposite of a normal option where the gamma increases towards maturity, assuming it not too far from ATM status.

Average rate options: variations

There are some variations to the AVRO which have been designed to meet more specific customer requirements.

Forward start average rate options

The forward start AVRO is a product which differs only slightly from a conventional AVRO in that the first reference fixing for the average will take place in the future (on a specified date). The AVRO then continues to average in the same way as a normal AVRO and, at maturity, is settled in the same way, i.e. cash settlement. This variation allows a company to hedge in advance, perhaps at a time when the current spot FX level is considered to be advantageous.

The cost of a forward starting AVRO is usually a little higher than that of a regular AVRO as, before the averaging period begins, the option behaves like a normal plain vanilla European-style option. As a general rule, the longer the forward start period and the shorter the average period, the more it behaves like a plain vanilla with the accompanying higher premium cost. So, for example, a forward start AVRO with a one-month forward start period and 11-month averaging will be cheaper than one with the same strike and amount for a three-month forward start and a nine-month averaging period.

A forward start average rate option with one fixing - on the last day - is the same as a plain vanilla European-style option.

Weighted average rate options

The conventional AVRO and the forward start AVRO assume that the buyer is hedging the same amount of currency on each fixing date. In practice, many companies experience irregular-size cash flows, owing to seasonal factors for example, and the more irregular or violent these swings, the less

efficient the hedge provided by the regular AVRO. The weighted AVRO remedies this problem.

As long as the amounts of each cash flow can be projected, the weighted AVRO can be used. The mathematics are slightly different in order to take care of the weighting required and, at maturity, the strike price is compared to the weighted average of the fixings to calculate the cash settlement (if any). The cost of a weighted AVRO is not easy to predict as so much depends on the weighting and how much it varies from fixing date to fixing date. Generally, if the cash flows are larger at the beginning and then decrease in size, the cost will be lower than if the reverse were true.

Summary of average rate options

It can be seen from the descriptions of AVROs that they can provide an efficient solution to FX risk as encountered by many companies. The flexibility of the AVRO's structure allows each option to be tailored to suit individual requirements. For example, a company's budget rates could be guaranteed by using AVROs and yet full benefit could be taken from beneficial moves in the underlying rate - the basic principle of all options purchased.

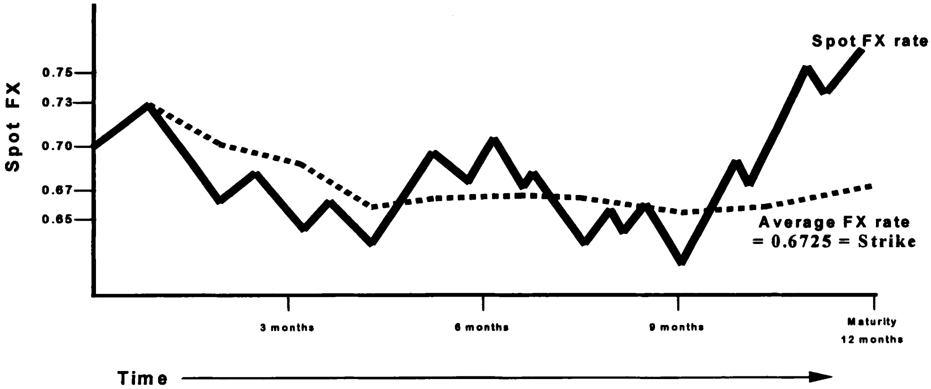
For the buyer, the AVRO is much more cost effective (lower premium) than the equivalent regular European-style option and one option can cover many cash flows, thus saving administrative expenses. For the writer, credit risk is reduced to near zero owing to the cash settlement feature on maturity (no exchange of currencies), leaving the premium receipt the only consideration (this can also be avoided by having the buyer's funds on account).

Finally, it should be noted that all types of AVRO collectively form just one of a series termed 'path dependent'. These options have payout profiles that depend on the movement of the underlying (spot FX rate) during the life of the option, rather than just on maturity in the case of regular options. Thus AVROs are path dependent, but compound options are not.

Average rate options are reasonably popular and are used primarily for hedging purposes.

Average strike options

Another path dependent option, the average strike has fixing dates similar to the AVRO but no initial strike rate is set. Instead, the spot rate fixings are averaged on maturity of the option and this average becomes the strike rate of the option. Comparison is then made with the prevailing spot rate to determine whether exercise should take place. Settlement is by exchange of currencies as with regular options, but cash settlement may also be used, if required.



11.3 Average strike option, 12 months tenure, strike EUR/GBP 0.6725 (being average of spot at expiry).

Figure 11.3 shows a one-year average strike option where strike is set on maturity at the average spot rate over the 12 months - EUR/GBP 0.6725. The example in Fig. 11.3 shows the average strike *call* to be in the money at expiry and by a substantial amount owing to the late, and sharp, increase in the spot rate over the three months of the averaging period. This large intrinsic value of over nine 'big figures'[63] (spot at expiry 0.7675 minus strike of 0.6725) is in stark contrast to the average *rate* option (Fig. 11.2) where the call at strike of 0.70 finishes out of the money relative to the same average rate of 0.6725 over the same 12-month period.

Average strike options are used more for speculative rather than hedging purposes.

Barrier options

Barrier options (sometimes referred to as trigger options) are also in the path dependent group[64] of exotic options and consist of two types that we shall

63 Reminder: big figure is usually the second decimal place in the FX rate. For example, if EUR/GBP spot is quoted as 0.6500; the big figure is the '5' so, if this rate moved up to 0.6700, that would represent a change of two big figures or 200 FX points (i.e. there are 100 FX points to a big figure). In FX rates that are quoted to less than four decimal places, e.g. USD/JPY 126.00, the big figure will vary accordingly – in this case it is 1 JPY (1.00).

64 Reminder: path dependent means that the option has a payout at maturity dependent on the movement of the spot FX rate during the life of the option, rather than just on maturity in the case of regular European-style options. Hence the maturity value or aspect depends on *how* the spot FX rate *arrived* at the level on option expiry.

refer to as knock-out or knock-in although other terms are frequently used such as kick-out/in or drop-out/in. They are regular European-style options with a twist - the option can disappear with a knock-out barrier option, or be created with a knock-in barrier, if the underlying spot FX rate hits a pre-set barrier or trigger point. The barrier can be set either above or below the current spot FX rate, resulting in two types of knock-out - up and out and down and out - and two types of knock-in - up and in and down and in - giving four kinds of barrier options and we shall look at examples of each type in this chapter. Because of the extinguishing or activating features of barrier options, they are cheaper than ordinary European-style options and so are popular with option purchasers who are premium adverse - the corporate treasurer in particular.

In a regular European-style option, the strike is always relevant to the forward FX rate, except on maturity when the underlying forward rate for that option finally becomes the current spot rate. The addition of the barrier feature (which is only relevant to the current spot rate) means there are now three FX rates that impact on the pricing of the option - the strike, the forward FX rate and the barrier rate. The relative position of the three, in relation to each other at inception, is important and should be clearly understood.

For example, in a European-style option there is a simple relationship between strike and the underlying FX rate in that the strike is either above or below the FX rate, giving just *two* variables - one use of which determines whether the option is in ITM or OTM:

1	FX rate	Strike
2	Strike	FX rate

The introduction of the barrier increases the two variables to six. The importance of the spot FX rate may now 'overshadow' the underlying forward FX rate so we shall use spot as the term in detailing the following six variables of barrier options:

1	Spot	Strike	Barrier
2	Spot	Barrier	Strike
3	Strike	Spot	Barrier
4	Strike	Barrier	Spot
5	Barrier	Spot	Strike
6	Barrier	Strike	Spot

These six variations can be applied to both calls and puts making 12 combinations, each of which can be either a knock-out or a knock-in, so a grand total of 24 different types of barrier options! Of these, two act identically to a regular European-style one and another two have no value at any point, leaving a net 20 types.

If we ignore the spot FX rate, and only look at the strike/barrier relationship, then there are only eight (strike/barrier (2), call/put (2), knock-out/knock-in (2) or $2 \times 2 \times 2 = 8$). These eight are encompassed in the four descriptions below, starting with 'up and out'.

When discussing barriers and other exotic options, comparison is often made with the regular European-style options with similar strike, date, etc. As mentioned earlier, the European-style option is often referred to as a plain vanilla, or just vanilla, option. This piece of jargon is now entrenched in the market-place, both with traders and theorists and we will therefore use the term frequently throughout the rest of this chapter.

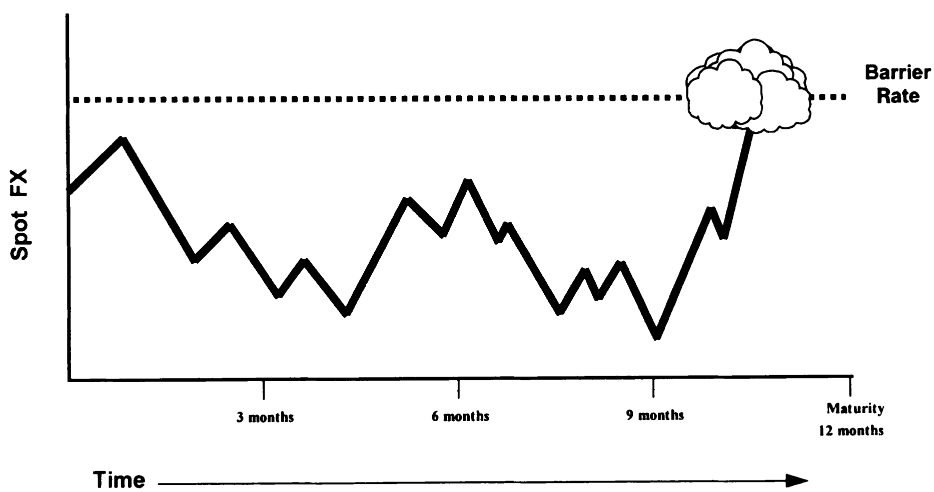
Up and out knock-out barrier

The barrier is set *above* strike. The up and out knock-out barrier (see Fig. 11.4) can be defined as:

> A European-style currency option that ceases to exist if a pre-specified FX rate (the barrier level) is touched at any time before maturity.

Example 1:
A United Kingdom importer has FX risk in GBP falling against the USD. To negate this risk, the importer buys a one-year GBP put (USD call), struck at 1.60 (ATM, spot) with knock-out barrier of 1.70; premium 4.88 of GBP%.

In this example, the importer is fully protected against GBP falling against the USD by the purchase of the GBP put struck at 1.60, the current spot rate.



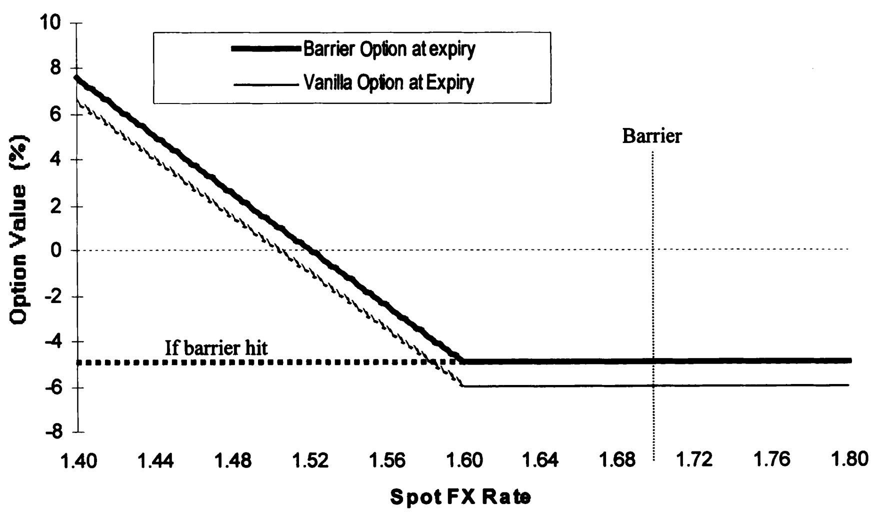
11.4 Up and out knock-out barrier.

However, a rise in the value of GBP would result in the option being cancelled at the 1.70 barrier point, but the importer would benefit from his underlying FX position (long GBP against USD) by purchasing USD more cheaply than if GBP was at a lower level. As shown in Fig. 11.5 this knock-out option provides the same benefits as a regular GBP put option providing the spot GBP rate does not retrace (after hitting the barrier) back to, and below, 1.60 where the importer no longer has the protection of the 1.60 put.

In the above example, a vanilla GBP 1.60 put (USD call) for one year would have cost 5.90%, against the 4.88% for the barrier. The premium cost can be lowered further by moving the trigger level closer to spot; for example, a barrier set at 1.65 would reduce the premium to 3.26% and at 1.62 to 1.55%.

This cost saving has to be weighed up against the risk of the FX rate retracing to the original level after knocking out the option at the set trigger point. Thus the up and out barrier option will perform the same as an ordinary European option, providing the spot rate never reaches the barrier during the life of the option, i.e. spot can go down (to any degree) or up (but only to just short of the barrier level).

However, the hedger does have the opportunity to buy USD (sell the GBP) if the barrier is triggered (and the option is lost) by simply transacting



11.5 Long GBP up and out 1.60 put (USD call), with knock-out at 1.70, premium paid 4.88% of GBP. Regular European long GBP 1.60 put (USD call), premium 5.90%, is also shown.

Current spot rate = 1.60; barrier at 1.70. Barrier option profile (thick line) is where barrier is *not* touched.

a spot deal at that point - 1.70 in the original example. This rate is substantially better than the original spot level of 1.60 and more than compensates for the premium paid (4.88% = 780 FX points[65] against spot level 1000 points better). Against this benefit, one has to assess the effect of the forward swap rate (at time of knock-out) as this may reduce the gain through selling GBP (buying USD) *at spot* (instead of the original forward date at option maturity) when the barrier is touched. For example, if the above option is knocked out after nine months and the importer sells GBP and buys USD at spot for 1.70, there may be a cost of 100 points or so to swap the exchange from spot to the original maturity date.

Returning to the barrier option, the pricing of a knock-out barrier option reflects the probability of spot reaching the trigger point. Thus, the nearer the barrier to the current spot rate, the cheaper the option (the higher the chance of the barrier being hit); the further the barrier is set from spot, the more expensive the option (the lower the chance of the barrier being hit). At the point where the theoretical probability of the trigger being hit is zero, the barrier option premium will be the same as the plain vanilla.

The up and out barrier is usually constructed with the trigger point set OTM relative to strike (as in the earlier example with the GBP *put*). Such an option is sometimes referred to as a regular, or OTM, knock-out. An up and out that has the barrier set ITM relative to strike (a GBP call in the above example) produces a seemingly odd scenario of an option that has increasing intrinsic value[66] that suddenly disappears at the barrier point. Figure 11.6 shows the payout diagram of such an option compared with the regular European.

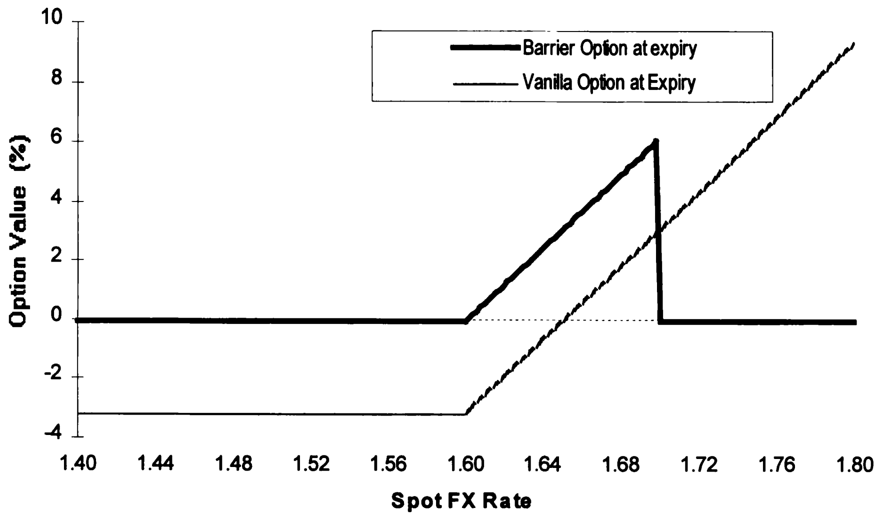
Options such as this are sometimes called reverse[67] knock-outs or in the money knock-outs and are said to have discontinuous payouts[68] - unlike the continuous payout feature of European-style options and plain FX. Note, in

65 Reminder: an FX point is usually the fourth decimal place in the exchange rate. For example, in GBP/USD, one point is 0.0001 – if GBP goes up from 1.50 to 1.60, this represents an increase of 0.10 in the rate, or 1000 points. A point represents the (normal) minimum movement in the exchange rate when traded in the FX market, hence in some currencies a point may be the second decimal place (e.g. JPY/USD spot moves from 121.15 to 121.20 which is a move of five points).

66 Reminder: intrinsic value is that amount that would be received by exercising an option, i.e. the difference between strike and underlying FX rate.

67 The term reverse barrier was introduced by FENICS – the OTC market standard software for FX options pricing – as: 'A barrier option in which the likelihood of being triggered increases as the option's intrinsic value increases'.

68 Not all in the money barriers have discontinuous payout profiles – it depends on the spot/barrier/strike relationship but all reverse barriers have discontinuous profiles.



11.6 Long GBP up and out 1.60 call (USD put), with knock-out at 1.70 (i.e. an ITM or reverse knock-out), premium paid 0.08% of GBP. Regular European long GBP 1.60 call (USD put), premium 3.19%, is also shown.
Current spot rate = 1.60; barrier at 1.70.

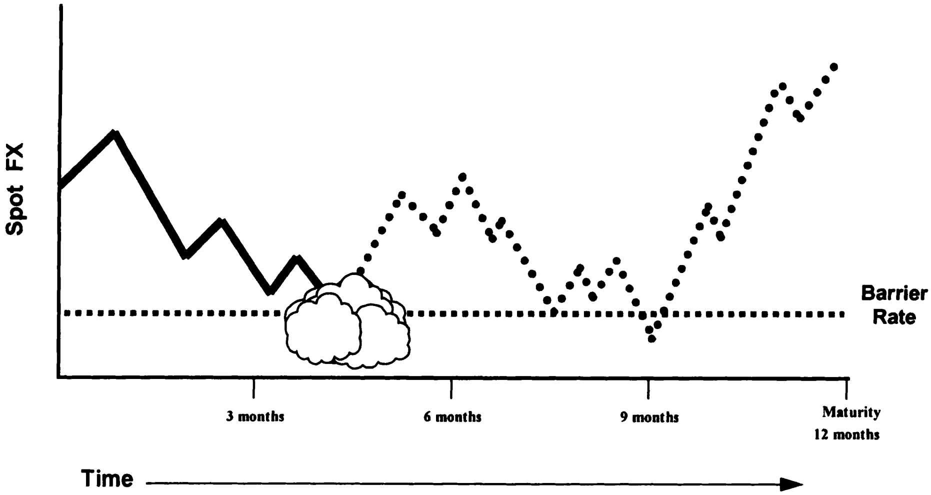
Figure 11.6, the continuous payout profile of the vanilla option compared to the abrupt discontinuity of the ITM, or reverse barrier option. The price of this type of option can be very low compared to the regular European option and they are used extensively for speculation or high risk hedging strategies.

For example, the purchase of the option in Fig. 11.6 would provide full protection against a rise in the GBP/USD rate up to the barrier level of 1.70 at a tiny cost. For the corporate hedger, such a scenario might be employed on the basis that the company felt that the GBP/USD rate was more likely to fall than rise and if it did go up, the barrier rate of 1.70 was not an achievable level. Such thinking goes against the mathematical probability of spot touching the barrier and thus makes the use of the reverse barrier option a very risky hedging strategy. However, employing such an option to cover the first 1000 points of a rise in GBP for such a tiny premium is definitely better than doing nothing at all.

Down and out knock-out barrier

The barrier is set *below* strike. The down and out knock-out barrier can be defined as:

> A European-style currency option that ceases to exist if a pre-specified FX rate (the barrier level) is touched at any time before maturity.



11.7 Down and out knock-out barrier.

The knock-out down and out option ceases to exist if the underlying spot rate falls to a predetermined level and, like the up and out, is usually constructed with the barrier set OTM. Figure 11.7 shows a one-year down and out barrier that is knocked out after just four and a half months with the final (after one year) spot finishing higher than at inception.

Example 2:
The UK branch of an American company has local expenses in sterling but income, and accounting, is in US dollars. The sterling expenses are open to risk in the GBP rising where each pound will translate into more USD. The budget has been set at an exchange rate of GBP/USD 1.60.

To protect against the rise in GBP, the company buys a GBP call (USD put) struck at 1.60, with a barrier of 1.50. The current spot rate is 1.60 so the option is ATM, spot.

In this example, the UK branch is fully protected with GBP above 1.60 by the call, but has a barrier of 1.50 at which point the option ceases to exist, should the spot rate drop to that level during the option's life span. However, at 1.50 the bank can buy GBP to cover its expenses at a lower rate and is therefore not concerned with the loss of the original 1.60 vanilla call.

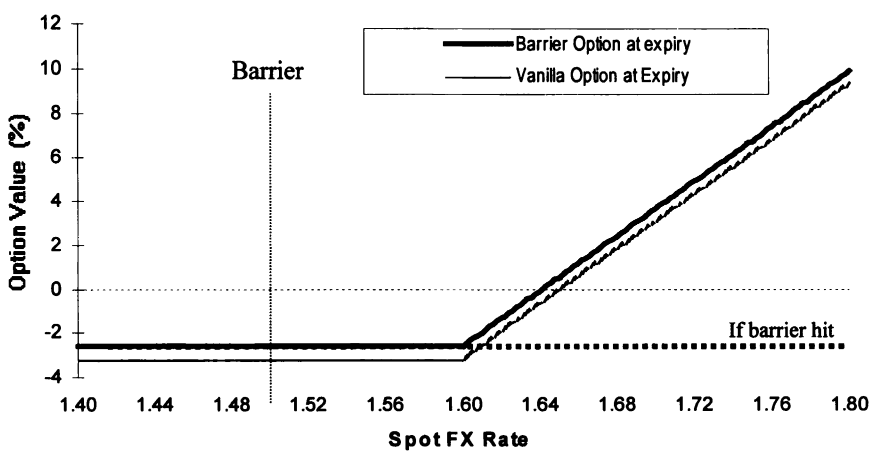
As with the up and out barrier, the down and out is cheaper than the straight European or plain vanilla option. Using the above example, for a one-year 1.60 GBP call (USD put) with a barrier at 1.50, the cost is 4.18 US cents (418 USD FX points) compared with 5.11 US cents (511 USD points) for the ordinary European GBP call (USD put). The payoff is the same provided that the spot GBP FX rate does not drop to 1.50 where the option

would cease to exist (hence down and out). The risk versus the straight European 1.60 GBP call is that it is possible for the spot rate to return to the 1.60 area, or above, *after* triggering the option cancellation at 1.50, leaving the branch with no protection (and having already paid a premium).

Against this, the branch would have had the opportunity to lock-in a much better rate for buying GBP at the barrier level of 1.50, if touched. At this level of spot, the bank would have been better off by 1000 FX points (1.60-1.50) even though a premium of 418 points would have been paid for an option that has just 'disappeared'. Furthermore, any forward swap of the delivered spot FX at 1.50 (i.e. to the original maturity date) would result in a further credit as the position is long GBP (short USD) which gains by virtue of the forward GBP/USD rate being lower than spot (i.e. at a discount), provided that GBP interest rates are higher than USD.

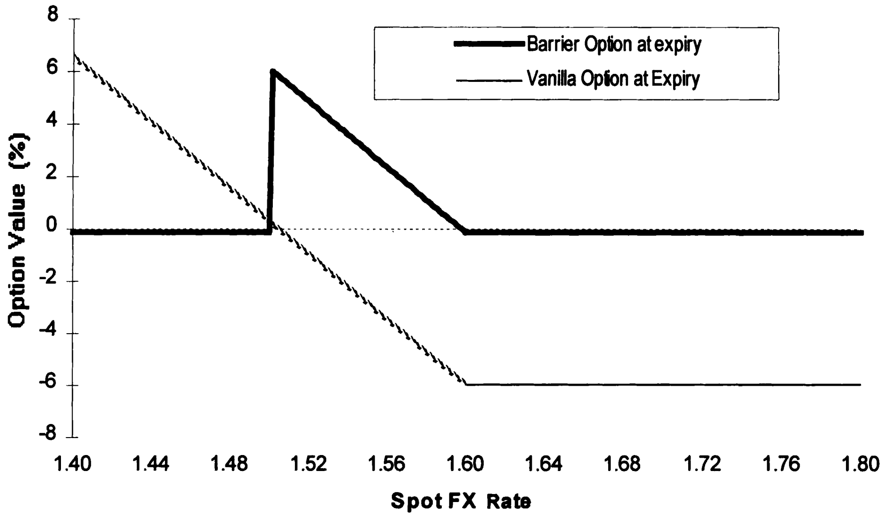
Figure 11.8 shows the barrier of 1.50 has been set OTM with regard to the strike rate of 1.60, which is normal for this type of barrier option but, as with the up and out, the down and out barrier can be set with the trigger rate as ITM - for example, if the above option has been a GBP put struck at 1.60 with the barrier at 1.50. Figure 11.9 shows the payout diagram for this, compared to a plain vanilla GBP put. One can see the discontinuous payout nature of this option and that the price of such an option can be very low compared to the regular European.

ITM knock-outs are used extensively for speculation or high risk hedging strategies. For example, the purchase of the option in Fig. 11.9 would



11.8 Long GBP down-and-out 1.60 call (USD put), with knock-out at 1.50, premium paid 4.18 US cents (2.61%). Regular European long GBP 1.60 call (USD put), premium 5.11 US cents (3.19%) is also shown.

Current spot rate = 1.60; barrier at 1.50. Barrier option profile (thick line) is where barrier is *not* touched.



11.9 Long GBP down and out 1.60 put (USD call), with knock-out at 1.50 (i.e. an ITM or reverse knock-out), premium paid 0.12% of USD. Regular European long GBP 1.50 put (USD call), premium 5.90%, is also shown.
Current spot rate = 1.60; barrier at 1.50.

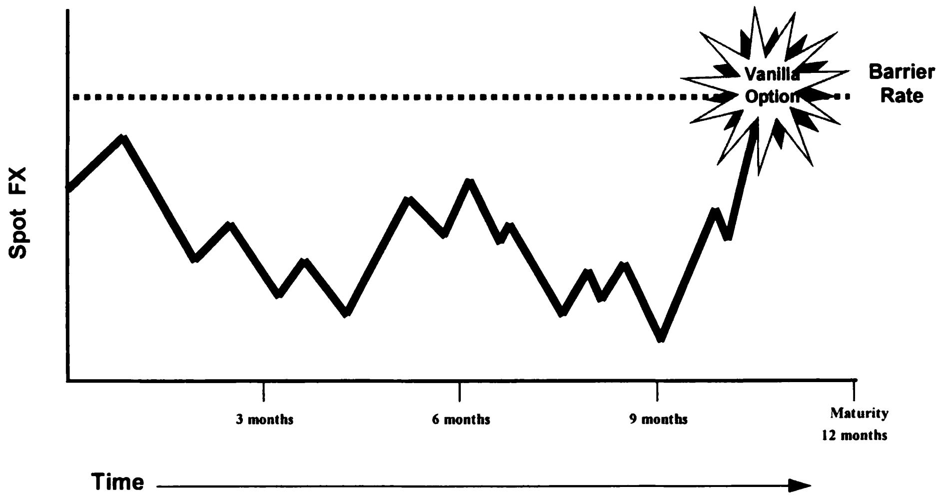
provide full protection against a fall in the GBP/USD rate down to the barrier level at 1.50 at a tiny cost. For the corporate hedger, such a scenario might be employed on the basis that the company felt that the GBP/USD rate was more likely to rise than fall and, if it did go down, the barrier rate of 1.50 was not an achievable level. Such thinking goes against the mathematical probability of spot touching the barrier and thus makes the use of the reverse barrier option a very risky strategy. However, employing such an option to cover the first 1000 points of a drop in GBP for such a tiny premium is definitely better than doing nothing at all (itself a very popular strategy).

Up and in knock-in barrier

The barrier is set *above* strike. The up an in knock-in barrier (see Fig. 11.10) can be defined as:

> A European-style currency option that can only be exercised if a pre-specified FX rate (the barrier level) is touched at some time before maturity. The moment the barrier is touched, the knock-in effectively becomes a vanilla option.

The last two knock-out barrier options each had a feature whereby the option was cancelled when spot reached a trigger point (the barrier). The



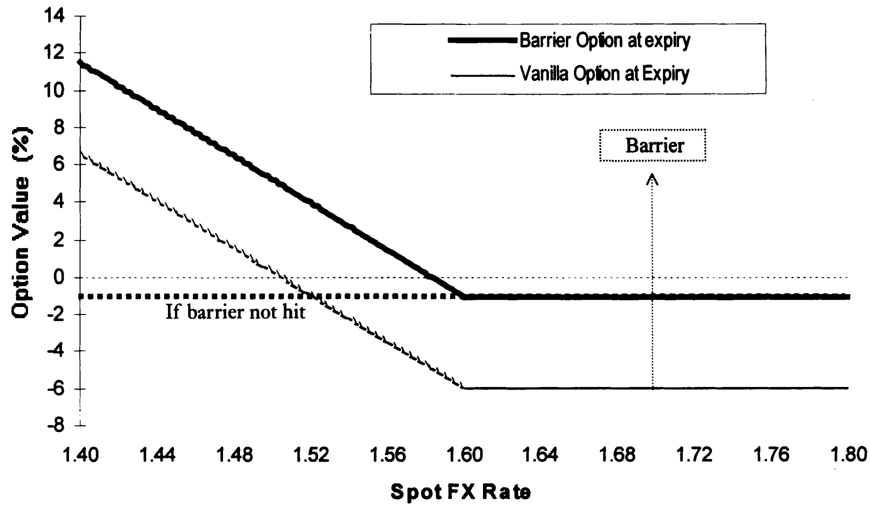
11.10 Up and in knock-in barrier.

two knock-ins (up and in and down and in) each have an option creation feature when spot reaches the barrier point. The first of these is the up and in barrier option where no option exists until spot climbs to the trigger point.

Example 3:
A speculator believes that a forthcoming United Kingdom general election will be won by the existing government. In this case, the GBP/USD rate (currently 1.60 USD per GBP) is likely to go up on such a result. However, the speculator also believes that such increase in sterling will be short-lived and ultimately GBP will devalue against the USD.

The speculator buys an up and in barrier option, a one-year GBP put (USD call) struck at 1.60 (ATM spot) with trigger point at 1.70. The premium is small - 1.02% or 163 FX points (1.02 × 1.60).

In this example, no option exists unless the spot GBP/USD exchange rate increases to the trigger, or barrier, of 1.70. At this point, the 1.60 GBP put (USD call) is created to mature on the original maturity date. If this event occurs, the option buyer will be looking for the GBP/USD rate to reverse and decline to below 1.60 where the option will have intrinsic value. Hence, an up and in barrier option will only suit a buyer who expects the reversal of the exchange rate, such as the speculator in the example. Figure 11.11 shows the (regular) put profile with continuous payout and looks very cheap compared with the vanilla but, of course, the barrier has to be reached before such profile can exist, otherwise loss of premium will result at all spot levels.



11.11 Long GBP up and in 1.60 put (USD call), with knock-in at 1.70, premium paid 1.02%. Diagram shows profile ***if knocked in***, otherwise loss of premium will result. Regular European long GBP 1.60 put (USD call), premium 5.90%, is also shown.

Current spot rate = 1.60; barrier at 1.70. Barrier option profile (thick line) is where barrier is touched.

The price of this knock-in option, 1.02%, compares very favourably with the ordinary 1.60 GBP put (USD call) at 5.90% and retains the continuous payout profile. However, imagine what would happen if the buyer was to wait until spot reached 1.70 before buying an ordinary 1.60 GBP put (USD call), rather than buy the up and in.The cost of the vanilla would vary according to the time taken for spot to climb to 1.70 and other factors such as the level of traded volatility. For example purposes, we will assume no change in volatility and look at the following various times to maturity:

Time elapsed	Option term	Price
1 month	11 months	2.70%
2 months	10 months	2.47%
3 months	9 months	2.20%
6 months	6 months	1.40%

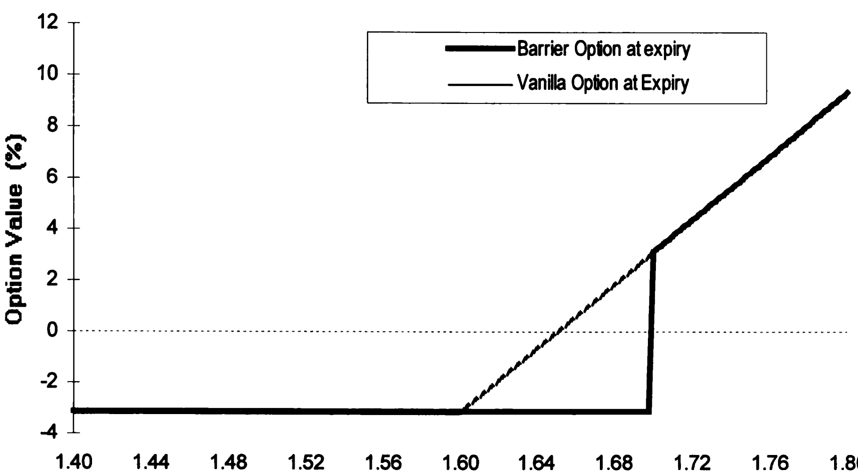
After one month, the cost of an 11-month GBP put (USD call), with spot at 1.70, would be 2.70% US cents; after two months, 2.46%, etc. Even after six months, the cost (of a six-month option) would still be 1.40%.Therefore, the up and in barrier is an inexpensive way of buying an option, but the buyer needs more than one event to occur to benefit from the transaction - the

spot GBP/USD rate must first move up to the barrier during the period selected, reverse direction, then regain all the 'lost ground' back to the strike rate before the option expires. This is a lot to ask for and is typical of a speculative viewpoint. As a result, knock-in barrier options are not normally employed as hedging strategies by corporate companies.

The pricing of a knock-in barrier option reflects the probability of spot reaching the trigger point. Thus, the nearer the barrier to the current spot rate, the more expensive the option (the higher the chance of the barrier being hit); the further the barrier is set from spot, the cheaper the option (the lower the chance of the barrier being hit).

Up and in barriers are usually constructed using trigger points that are OTM relative to strike, as in the above example. An up and in that has the barrier set ITM relative to spot (a GBP call in the above example) produces a seemingly odd scenario of an option that has an underlying increasing intrinsic value that does not exist unless the spot rate reaches the barrier point.

Figure 11.12 shows the payout diagram of the ITM barrier (or reverse barrier) option compared with the regular European. In this case, the buyer of the reverse up and in has no vanilla option until the barrier is triggered at 1.70, even though the spot rate may have moved favourably (i.e. up). There is little difference in the premium compared to the plain vanilla, which states that there is a high mathematical probability that the option will be knocked in during the one-year life. The price of this option has been computed using a traded volatility of 11.5% (pa). One can calculate the implied trading range



11.12 Long GBP up and in 1.60 call (USD put), with knock-in at 1.70 (i.e. an ITM or reverse knock-in), premium paid 3.11% of USD. Regular European long GBP 1.50 call (USD put), premium 3.19%, is also shown.

Current spot = 1.60; barrier at 1.70.

within one standard deviation (about 66% probability) as 1.4350 to 1.7840 (1.60 divided by 1.115 and multiplied by 1.115 respectively). Although this calculation is simplistic, one can see it encompasses the 1.70 trigger level. So a lower traded (implied) volatility rate will reduce the premium of this option as it will reduce the likelihood of spot touching the barrier of 1.70.

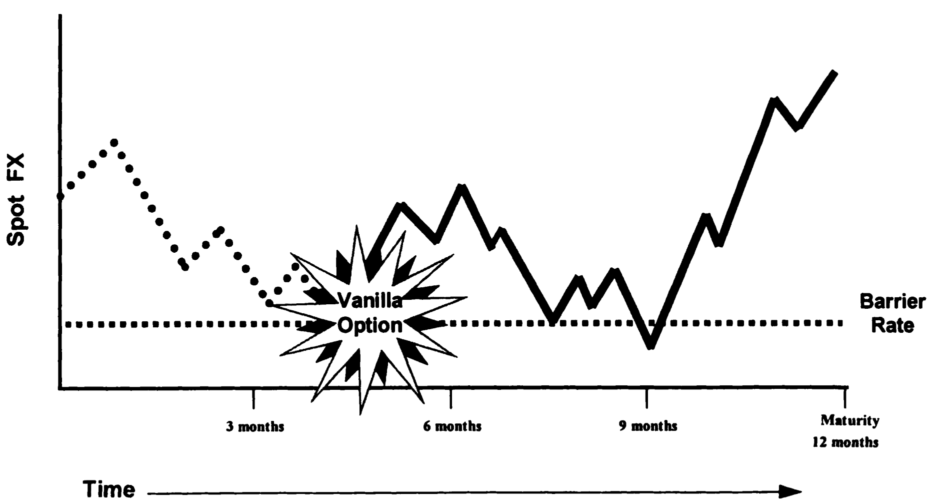
Reverse knock in barrier options can be employed as hedging strategies but the saving in premium cost (against the equivalent vanilla) is not always sufficient to warrant the extra risk of spot *not* reaching the barrier.

Down and in knock-in barrier

The barrier is set *below* strike. The down and in knock-in barrier (see Fig. 11.13) can be defined as:

> A European-style currency option that can only be exercised if a pre-specified FX rate (the barrier level) is touched at some time before maturity. The moment the barrier is touched, the knock-in effectively becomes a vanilla option.

The down and in option is created only when the spot FX rate declines to a specified barrier, or trigger, point. Like the up and in option, its use seems to be speculative and can be applied to cases where the spot FX rate is expected to go down to a certain level, the barrier point, and then reverse to climb back up to, and beyond, the strike rate.

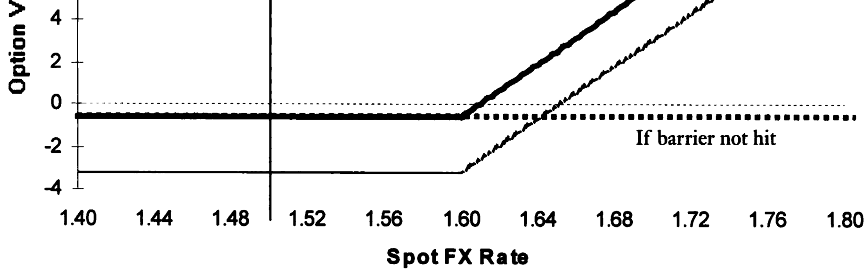


11.13 Down and in knock-in barrier.

Example 4:
A speculator feels that the GBP/USD exchange rate will fall sharply if unexpected interest rate cuts are announced, but will recover steadily from the lows as the stock market and government bonds market pick up through overseas investment.

The speculator buys a GBP call (USD put) struck at GBP/USD 1.60 with down and in barrier set at 1.50.The current spot rate is 1.60 and the premium for the one-year option is just 0.58% or 93 FX points.

The tiny premium of 0.58% compares to 3.19% for a regular European 1.60 GBP call (USD put) for one year but, of course, the GBP/USD rate has to decline 10 cents from the current spot rate of 1.60 before the option is created. If this event does occur, then the buyer has to see the rise in GBP/USD to beyond 1.60 by the maturity date. These circumstances are mathematically 'long odds' and the very small premium reflects the probability of the events occurring. Nevertheless, there is very little to lose and such 'bounces' in exchange rates do occur frequently in the marketplace. The timing of this, and the setting of the trigger point, is where one needs a bit of luck. Figure 11.14 shows the classic continuous payout profile for a GBP call option and the barrier looks very cheap compared with the vanilla but, of course, the barrier has to be reached before such a profile



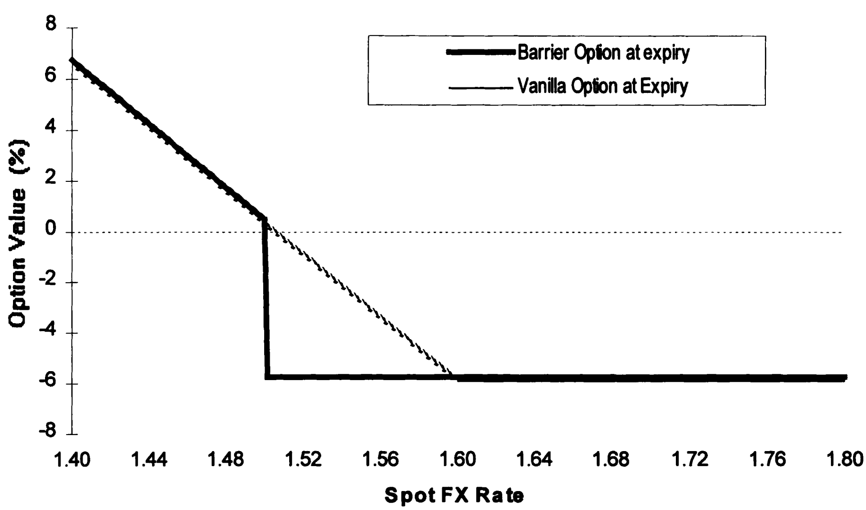
11.14 Long GBP down and in 1.60 call (USD put), with knock-in at 1.50, premium paid 0.58%. Diagram shows profile ***if knocked in***, otherwise loss of premium will result. Regular European long GBP 1.60 call (USD put), premium 3.19%, is also shown.

Current spot rate = 1.60; barrier at 1.50. Barrier option profile (thick line) is where barrier is touched.

can exist otherwise loss of premium will result at all spot levels. As a result, knock-in barrier options are not normally employed as hedging strategies by companies.

Down and in barriers are usually constructed using trigger points that are OTM relative to strike, as in the above example. A down and in that has the barrier set ITM relative to strike (a GBP put in the above example) produces a seemingly odd scenario of an option that has an underlying increasing intrinsic value that does not exist unless the spot rate reaches the barrier point of 1.50. Figure 11.15 shows the payout diagram of the ITM barrier (or reverse barrier) option compared with the regular European.

In this case, the buyer has no vanilla option until the barrier is triggered, even though the spot rate has moved favourably (i.e. down). There is little difference in the premium compared to the plain vanilla, which states that there is a high mathematical probability that the option will be knocked in during the one-year life. The price of this option has been computed using a volatility of 11.5% (pa) which, simply put, gives a potential spot variance of ±11.5% from 1.60, or a range of 1.4350 to 1.7840 which clearly encompasses the 1.50 trigger level. So a lower traded (implied) volatility rate will reduce the premium of this option as it will reduce the likelihood of spot touching the barrier of 1.50.



11.15 Long GBP down and in 1.60 put (USD call), with knock-in at 1.50, premium paid 5.78% of USD. Regular European long GBP 1.60 put (USD call), premium 5.90%, is also shown.

Current spot rate = 1.60; barrier at 1.50.

Reverse knock-in barrier options can be employed as hedging strategies but the saving in premium cost (against the equivalent vanilla) is not always sufficient to warrant the extra risk of spot *not* reaching the barrier.

Barrier parity

Like many things in options, barriers are less complicated than they might at first appear. With regular European-style options, there is really only one derivative - the option - and whether it is a call or put is irrelevant because we can convert one to the other through the underlying FX (put–call parity). It is the same with barriers. There is only one derivative - the barrier - but, in this case, it is split into two by the direction of the trigger, otherwise we could convert one into the other through the underlying regular European option.

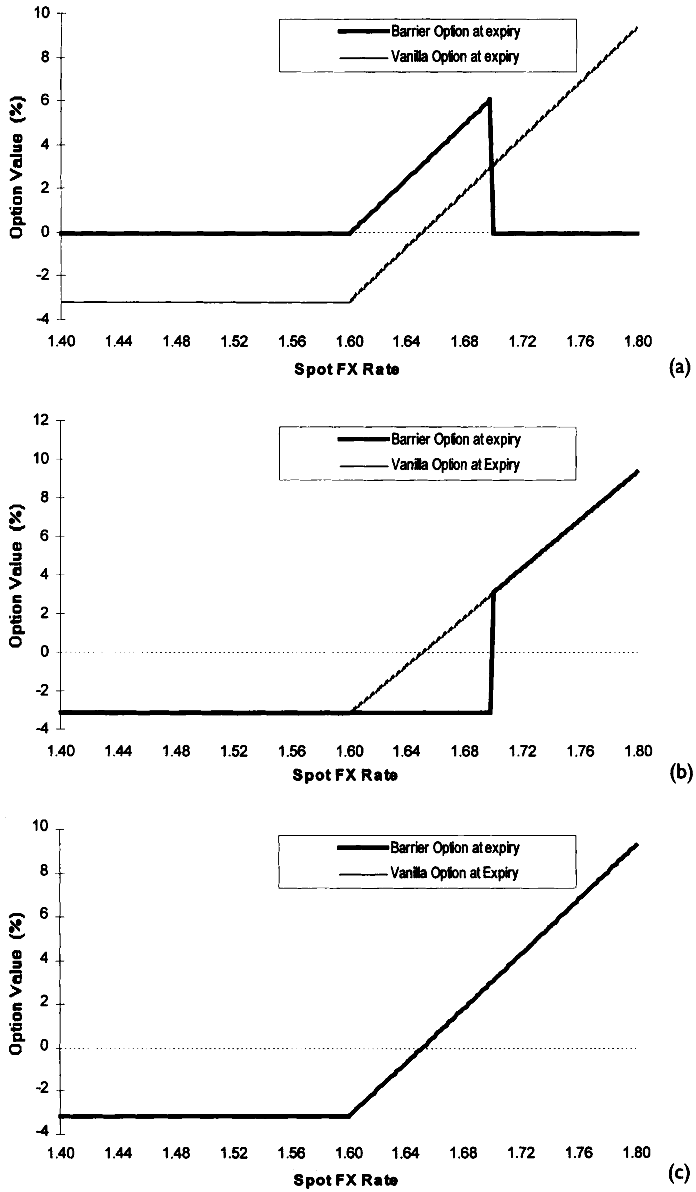
For example, consider the case of buying an up and out and an up and in option with the same strike, barrier, amount and maturity. The buyer would have one option that would be cancelled and one option that would be created when spot rises to the common trigger point. In all cases the buyer always has the option, whatever happens, which is the same as buying a regular European-style option in the first place.

Note this very simple rule of barrier parity:

> Knock-out option + knock-in option = ordinary European option
> (*providing strike, trigger, amount and date are the same*)

This very simple formula can be used to calculate the price of one type of option, assuming the other two are known. It can now be seen from the examples that the regular GBP put (USD call) European-style option with a premium at 5.90%, less the up and out premium of 4.88% in Example 1 (page 153), gives the price of the up and in option with a premium of 1.02% in Example 3 (page 160). Similarly, the GBP call (USD put) European-style option equates to the down and out and down and in barrier options in Examples 2 (page 157) and 4 (page 164).

To further illustrate this simple parity, the three diagrams in Fig. 11.16 are repeated from the above examples using the reverse-type barriers to show, graphically, how the vanilla may be constructed from the respective knock-out and knock-in options.



11.16 (a) Long reverse 1.60 knock-*out* and (b) long reverse 1.60 knock-*in*; GBP 1.60 calls (USD puts) - both with barrier at 1.70 - together equal (c) vanilla GBP call.

(a) GBP 1.60 call is ITM (has an intrinsic value of 10 US cents) when knocked *out* at trigger level of 1.70. Premium - 0.08%. (b) GBP 1.60 call is ITM (has an intrinsic value of 10 US cents) when knocked *in* at trigger level of 1.70. Premium - 3.11%. (c) Vanilla GBP 1.60 call, premium 3.19%.

Barrier pricing

Regular OTM barriers are sometimes quoted in volatility terms similar to regular vanillas but other barriers - such as reverse knock-ins/knock-outs - are quoted only in premium terms owing to the unusual behaviour of vega in certain cases.

For example, it is possible to be *long* a reverse barrier option and yet be *short* vega[69] (in vanilla options, long option positions always carry long, or positive, vega).

How can this be?

Well, consider the fact that increasing volatility will increase the probability that spot may reach the barrier point thus *reducing* the price of a knock-out (but increasing the price of a knock-in). If the option price reduces on increasing volatility, then that gives us negative vega on a long barrier option position.

In such cases, gamma is also likely to be negative with theta positive - all the opposite of what is normal (for vanilla options). It is possible for delta to start out normal - positive for a bought call option - and then 'flip' over to being negative.

The relationship of current spot to the barrier level is all important in this respect.

For example, if we look at the example in the up and out reverse knock-out and Fig. 11.6 (1.60 GBP call with knock-out at 1.70) we will see that this option is valued at a tiny 0.08%. The volatility used to produce this premium value is 11.5% which is high enough to give a strong probability that spot will reach the barrier level of 1.70 in the one year of the option's life - hence the tiny premium. If we increase the volatility to 13.5%, then we further increase that strong probability and, in fact, the premium works out to be 0.05%, down from the 0.08%.

Staying with the example in Fig. 11.6, another fact arises - the 0.08% premium is unlikely to trade in the market at that theoretical level. In fact, this particular option is more likely to be priced around 0.25% with the equivalent knock-in's price *reduced* to 2.94% from 3.11% in order to equal the plain vanilla's premium of 3.19%. Many of the reverse barrier options trade, to a certain degree, above/below their theoretical value.

69 Reminder: vega represents the change in value of the option premium given a change in traded (implied) volatility. In vanilla options, increasing the traded volatility increases the uncertainty of exercise at maturity, thus increasing the premium.

The reason for this is somewhat similar to the effect of plain vanilla OTM options trading at implied volatility levels above the theoretical, or Black-Scholes, price. There is no allowance within the Black-Scholes model for the smile and skew effects of traded implied volatility (as discussed in Chapter 5) but, in the case of reverse barriers, it is not practical to adjust the volatility level so the market trades on the basis of increasing the premium value. The basic reason is the same in that these low priced options are considered to be too cheap and demand is always to buy, thus forcing the price up under good old fashioned supply and demand.

Theorists have been hard at work to explain what should be the correct price for options such as these and many have published papers detailing ways to come up with the right price but, of course, this is always with hindsight. In the end, the dealer with profits to make, the corporate with hedging to do and the speculator spotting what is good value is what makes the right price. As time goes on and more experience is gained with reverse barriers, then the market will eventually settle for a particular model or will end up trading the difference as a variable in a similar way as low delta strangles[70] and risk reversals[71] are traded in volatility terms for plain vanilla options.

Terminology

Up and out, up and in, down and out, down and in are nothing more than convenient terms to describe the direction of spot for trigger and the option type. After all, an up and out GBP put (USD call) is fine in terms of GBP - 'up' is spot increasing - but, in terms of USD, is not accurate. Up is a decreasing value for the dollar (the higher the number, the lower the dollar!) so, is this a down and out USD call (GBP put) or is it still considered to be up and out because the number increases? Whatever method is used for spot quotation, it is only the direction of the trigger that is important.

70 Low delta strangles – typically 25 delta – are used to trade the smile effect of volatility across option strikes and are quoted in volatility terms as a premium over ATM, 50 delta options.

71 Risk reversals – typically 25 delta – are used to trade the *difference* between calls and puts with strikes of similar delta (e.g. 25%) and are quoted in volatility terms as one being a premium over the other.

As a result of the potential confusion of describing up and down, many professional traders do not use the terms, just stating the strike and trigger levels and adding whether the option is a regular or reverse (ITM) knock-out or knock-in. For example, instead of 'Up and out GBP put, strike 1.60, barrier at 1.70', the trader might say 'Regular GBP knock-out, strike 1.60, barrier 1.70' - this barrier option has to be a GBP put because the GBP call would be ITM at the trigger making the option a reverse GBP knock-out.

FENICS has long been the market preference software for pricing FX options and, as such, has continually tried to encompass current trader jargon, where possible. In some cases, FENICS has introduced its own terms for certain aspects of option pricing or characteristics which have been adopted by the market generally. Reverse as in reverse barriers is one such term. Other bits of jargon introduced by FENICS have been less successful but, nevertheless, are quite useful to describe certain characteristics of options. Wealth, health and stealth are three such terms and are detailed below as two of these - health and stealth - apply only to barriers and other options that have the 'touch' feature and adequately describe the additional relationships created by the introduction of the barrier to the vanilla option.

Wealth

Wealth is the relationship between *strike and spot (forward)*. Previously called 'moneyness', wealth describes the amount by which the option is in, or out, of the money relative to either spot or the forward, hence 'spot wealth' and 'forward wealth'. For ITM options, the forward wealth is the intrinsic value for European-style options.

Wealth = (strike/underlying spot or forward) expressed as a percentage.

Example:
GBP call (USD put) strike 1.65; spot = 1.6000; forward = 1.5554
Spot wealth = 1.65/1.60 = 1.0312 = 3.12% OTM
Forward wealth = 1.65/1.5554 = 1.0608 = 6.08% OTM
The equivalent *put* would be *ITM* by the same percentage figures.

Health

Health is the relationship of current *spot* (or forward, for forward barriers) *to the barrier price*. It is essentially the wealth of the trigger portion of the option, taking into account the bias of the trigger. Thus, in FENICS, when a barrier option is currently not triggered, it is considered to have OTM health,

and an option with ITM health is considered triggered. Because the style of the option determines whether triggering is based on the spot or forward exchange rate underlying the option, FENICS will show only the health that corresponds to the style, either spot health or forward health, as appropriate.

Health = (barrier/underlying spot or forward) expressed as a percentage.

Example:
GBP call (USD put) strike 1.65; spot = 1.6000; forward = 1.5554
(Spot) barrier of 1.55
Spot health = 1.55/1.60 = 0.96875 = 3.33% OTM

The equivalent *put* would be *OTM* by the same percentage figures, but note that the option would have to be a reverse barrier otherwise it would have already been knocked out (in) - ITM.

Stealth

Stealth is the relationship of the ***barrier price to the strike price***. It can also be looked at as how far in or out of the money the vanilla part of the option will be when it is triggered. Most standard knock-outs and knock-ins have OTM stealth, meaning that the underlying vanilla option will be out of the money when it is triggered. All reverse knock-outs and reverse knock-ins have ITM stealth, but regular knock-outs and knock-ins may have this also. All barriers with ITM stealth will have intrinsic value when triggered and are therefore very difficult for bank option traders to hedge, especially as the option approaches expiry and as the underlying approaches the trigger.

Stealth = (barrier/strike)

Example:
GBP call (USD put) strike 1.65; spot = 1.6000; forward = 1.5554
(Spot) barrier of 1.55
Stealth = 1.55/1.65 = 0.9394 = 6.06% OTM

The equivalent *put* would be *ITM* by the same percentage figures, but note that the option would have to be a reverse barrier otherwise it would have already been knocked out (in).

Rebates

Occasionally, barrier options are constructed with rebates. These predetermined fixed payments are made under the following circumstances:

1 Knock-outs - a rebate is paid if and when the trigger point is hit, cancelling the option.
2 Knock-ins - a rebate is paid on maturity, providing the trigger has not been hit during the option's life.

Barrier options with the rebate feature are more expensive in premium terms than those without, because of the potential rebate. Rebate barriers are constructed through the purchase of a regular barrier option and a digital option; thus involving two premiums. Digitals are discussed in the next chapter on advanced hedging strategies.

Determination of spot touching barrier

The spot FX market is a true 24-hour market and, as such, one may need to know if spot is traded at the barrier point in some far off land at a particular time. The determination of whether spot trades at a particular level, or not, is not as easy as it may first seem and raises several interesting questions:

1 **Which party (the buyer or the seller) should be responsible in determining if spot has, or has not reached the barrier level?**

Obviously, one party will gain by the spot touching barrier event and the other will stand to lose. In plain vanilla options, the buyer determines whether or not to exercise on the seller and this procedure is very clear as the seller can only gain the premium received giving all benefits to the buyer. However, in barriers, a knock-out option will benefit the seller but a knock-in option will benefit the buyer, so who determines whether spot has, or hasn't, touched the barrier level can vary - it is not always the seller. To look at this point in another way, the seller will *want* spot to touch the barrier in a knock-out but will *not want* it to touch in a knock-in, giving a different perspective on spot determination should the barrier be close to the current spot rate.

2 **As FX is an OTC market, how can one bank know, for certain, if spot has been transacted at a certain level?**

Each spot FX transaction is a bi-lateral contract between two parties who have agreed to exchange certain currencies at an agreed rate on an agreed date. Such a transaction is not recorded on a central exchange and is only known to the two parties concerned. Take, for example, spot trading at 1.59 93-98 (i.e. bid 93, offered at 98) through a broker. Bank A calls Bank B on the Reuters Dealing System for a spot

price. Bank B, looking to buy, moves its bid/offer price up from the broker's quote to 1.59 95-01. Bank A decides to take the offer at 1.5001 (assume Bank A does not know the broker's price, or prefers to deal with Bank A for credit reasons) and a trade takes place at 1.5001. What if 1.5000 is the barrier level on an option at a third bank?

Another bank will have no knowledge of this deal or of the rate agreed, which happens to be above the barrier point. Of course, deals done through a FX broker (including the electronic kind) will be recorded by the broker and this does help in resolving the problem, but there are many, many transactions done directly between banks.

3 **Banks having the responsibility of determining if spot has reached the barrier may also be active in the relative spot market. What is there to stop such a bank from pushing the spot rate to, or from, a barrier level by trading in the spot market?**

This can be a real problem in illiquid markets. Even in the major currencies, spot FX rates have been seen to move dramatically late in the trading day - for example, in North America after 3.00 pm - on little real volume. The temptation for a bank to nudge spot towards the trigger (on a short knock-out or long knock-in) must be great in any circumstance but, consider the case of a reverse barrier option where there is a large intrinsic value at stake. The bank may be facing millions of dollar profit or loss by spot moving a small degree to the barrier.

4 **What if spot is *quoted* (but not traded) at, or beyond the barrier?**

In active markets, spot may move beyond a specific barrier point without actually trading and then return to its previous level. If looking at the information screens (such as Reuters, Telerate, etc) it will appear that spot has triggered the barrier. Does the fact that a bank was willing to buy/sell at a spot level beyond the barrier signify that the knock-in/knock-out has taken place? For example, on the listed exchanges, many of the closing prices will have not traded at all, despite the price moving from the previous day's close.

5 **What amount has to trade at spot to qualify the barrier being reached?**

Similar to regular vanilla options, barriers are often traded in large amounts, 50 to 100 million being quite common. Imagine being long a reverse knock-out in 100 million with intrinsic value of say, 5% (5 million dollars in profit/loss terms) that gets triggered on a 2 million

spot trade at the barrier with no following spot transactions taking place (at the barrier or beyond).

The answers to all these questions are far from complete but we do have some published guidelines thanks to the Barrier addendum in the 1997 ICOM terms (Chapter 14) which goes some way to establishing good market practice. Here follows a brief guide to current thinking and market practice:

1 A definition 'controller of the barrier' or 'barrier determination agent' (ICOM definition) has been devised. One of the two parties (i.e. the buyer or the seller) is appointed at the time of the transaction to undertake the responsibility of determining whether spot reaches the barrier and, if so, to notify the counterparty immediately. Usually, the controller of the barrier is the *market making* bank - the bank quoting a two-way (bid/offer) price - hence market *users*, such as corporate customers of the banks, are dependent on their bank counterparty to act professionally.

   Notification of who is the controller of the barrier should appear on the written confirmation of the transaction, together with the statement that such bank will act in good faith in determining if the barrier is triggered.

2 There is no real answer to this. A bank needs, therefore, to have third party evidence to quantify that a spot trade has taken place - a broker, for example - otherwise how can the spot (barrier) level be justified to the counterparty?

3 A bank dealing in spot to push it to the barrier for its own advantage is unethical, unprofessional and possibly illegal. However, it is clear that a conflict of interest exists in barrier options and users must be aware of such and ensure that their bank counterparty acts in good faith (see guideline 1 above). The 1997 ICOM terms give the example of a bank hedging and de-hedging its barrier option position in the spot FX market which may, by this action alone, influence the spot movement towards the barrier level. Clearly, such hedging is done to protect the bank against possible losses without intention of 'pushing spot' towards a particular barrier. Nevertheless, ICOM suggests that banks may wish to consider whether it would be appropriate to make a disclosure (that the bank is active in the FX markets and/or may be hedging its barrier options in the above manner) and to this effect provides some suggested wording for such a disclaimer for inclusion in the bank's confirmation.

4 It is generally agreed that spot *must* trade at or beyond the barrier rate making screen prices somewhat irrelevant. ICOM confirms the market practice in this respect.

5 A difference of opinion presently exists on this one. Attempts at trying to standardise how much, or the number of spot trades required, to justify 'knocking' have failed. There are some cases where banks have pro-rated the spot transaction size to the barrier option face value - for example, one 2 million spot trade would only knock-in/knock-out 2 million of the barrier. Another variation is to say that a 10 million spot trade is justifiable to knock the whole of any barrier so a 2 million spot transaction would knock 20% of the barrier face value, etc. Having said this, other banks might insist that any spot transaction size, to evidence that spot, has breached the barrier.

On this point, 1997 ICOM states that transactions must be of 'commercial size' - the amount which is generally accepted by foreign exchange dealers for the applicable currency - and suggests that the parties may wish, in the case of large barrier option transactions, to specify a larger minimum size for the potential spot trade that triggers the barrier.

In the end, it is very much up to the counterparties to agree on the above points before entering into a transaction. Banks should adhere to the 1997 ICOM recommendations, although customers and other users of the barrier options market might want to specify certain conditions to prevail and ask different banks for quotes based on such conditions. For example, some corporate customers in the past have specified something like 'spot must trade at least three times to a total of at least 50% of the barrier option face value' to cover point 5 above. Although against ICOM recommendations, a price based on such conditions would probably be made available by a few market makers owing to the competition for corporate business. Other banks might flatly refuse.

Some institutions have offered barriers tied to a particular daily fixing, e.g. the euro fixing for the EUR, as another way of getting over the problem. Such fixings are published in the daily financial press.

Barrier options: variations

There are many variations to the basic barrier options detailed above. For example, they may be constructed with specifications that only allow the option to knock out or in on a particular day, week or month - 'window' barriers. In these cases the knock-outs become more expensive and knock-ins become cheaper owing to the restriction.

All the examples under barrier options are constructed with the trigger point set as relative to the *spot FX rate* reaching (or not reaching) that point, which is normally the case. Barrier points can also be set against the forward FX rate, rather than spot; these options are known as forward knock-outs or

knock-ins or forward barriers. Such options are seldom traded owing, in part, to the problems of substantiating whether the forward rate has touched the barrier point. Given the problems outlined earlier with regard to the (simple) spot touching the barrier,[72] tracking a forward rate that comprises the spot and swap rate is not practical.

Barriers are used extensively with vanilla combinations to provide packaged strategies, such as bonus forwards, break forwards and the like, which have proven to be popular for corporate hedging and are discussed in the next chapter.

Furthermore, the examples are shown from the buyer's perspective only (hence the 'long' statement in the examples), whereas many institutions sell barriers as a lower risk form of selling regular European-style options.

Double barriers

A double barrier is a barrier option with *two* trigger points rather than one. Having two barriers means that one of them will be in the money and the other out of the money, relative to strike so we can dispense with those terms (ITM and OTM) for such options. Double barriers can be either knock-out (see Fig. 11.17) or knock-in and are usually constructed whereby the trigger event is the same at both barriers - i.e. the underlying vanilla is either knocked out *or* knocked in at *either* of the two barriers.

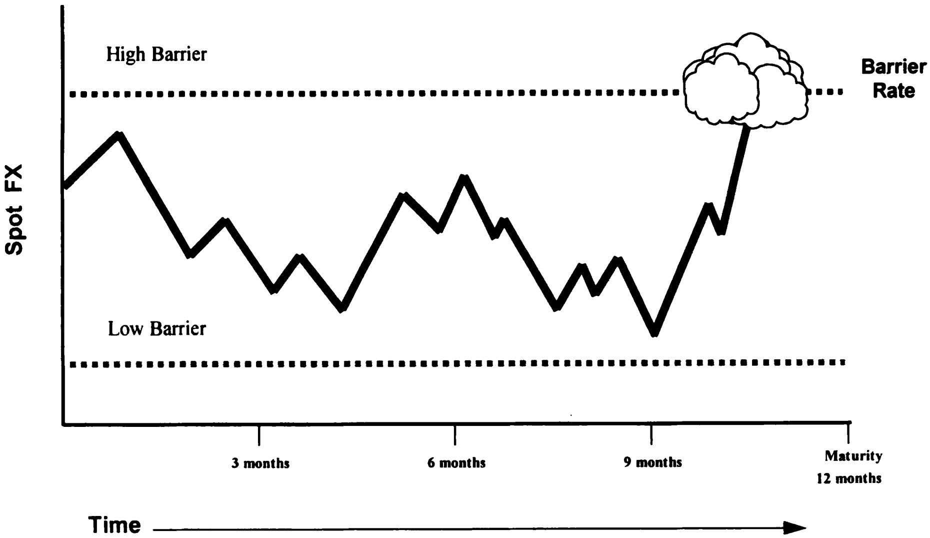
These standard double barriers are cheaper than single barriers on knock-outs owing to the increased chance of that event by having another trigger point. Double barrier knock-ins are more expensive than single barrier knock-ins by virtue of having an increased chance of being triggered by the additional barrier.

Double barriers used for hedging are very high risk - owing to the ITM trigger rate acting as a reverse barrier in a similar manner to the high risk reverse knock-out discussed earlier - except, this time, there is another barrier as well (albeit, OTM). Against this statement is the fact that the premium has been reduced even further.

Barrier parity holds true for double barriers in that the double knock-out and double knock-in *together* equal the plain vanilla option providing, of course, that the strike and two triggers are the same in both cases.

In addition to standard double barriers, it is possible to have non-standard double barriers where the event is different at one trigger than the other. For example, a knock-in and knock-out double barrier is an option that knocks *in* at one barrier level and can knock *out* at the other barrier level (regardless of whether or not it has yet been knocked in).

72 See 'Determination of spot touching barrier' earlier in this chapter.



11.17 Example of a knock-*out* double barrier.

Summary of barrier options

Barrier options have been around for some time but most of the original transactions were of the regular type when the barrier is set out of the money in respect of the strike - similar to the up and out knock-out barrier example. Furthermore, the spot FX rate would have normally been either at the money or out of the money, making these options relatively simple to comprehend.

Barriers that are in the money relative to strike - the reverse barrier options - produce discontinuous payout profiles like that shown in Fig. 11.6. These options have become popular over the last few years owing to the possibility of very low premiums with extremely high 'gearing'. In the early days, most banks refused to trade these options owing to the problems of hedging at the barrier point close to expiry. The banks that did trade them tended to lose money and there are more than a few (large) banks that have posted substantial losses in this area. The problem seemed to be that the theoretical price was too low/too high (depending on whether the option was a knock-out or knock-in) and these options now trade at substantial levels over/under the theoretical value. Most of the larger banks with quant[73] teams have developed their own models for pricing and hedging reverse

73 A quant is jargon for the relatively new breed of theorist now found in most dealing rooms. This person usually has a mathematics, or similar, discipline from university and has the responsibility to provide valuation models for pricing and hedging complex option structures. He/she may also undertake trading and/or sales responsibility for such products.

barrier options. Institutions transacting barrier options of the reverse type should be very wary of the risks involved and should validate pricing by checking with an established name in the market.

Barrier options found increasing popularity in 1996 when the spot FX market volatility declined substantially resulting in many currencies being 'range bound' - any movement of spot being confined to an established range of exchange rates. This low spot volatility set the stage for a mini boom in exotic options generally but also the demise of the underlying FX market. This has resulted in much more awareness of barrier and other exotic options.

All types of barrier options are now actively traded OTC between banks with most option brokers offering a service alongside the regular vanillas.

Lookback (optimal) options

Another option of the path-dependent type, the lookback call option, gives the purchaser the opportunity to buy at the lowest spot rate that existed during the life of the option. Likewise, a lookback put gives the opportunity to sell at the highest spot rate. This is done by setting the strike on maturity against the lowest spot rate (for a call) or the highest (for a put). In FENICS,[74] this is called an optimal strike option whereas the optimal rate option allows the buyer to use the lowest spot rate (for a put) or highest spot rate (for a call) against a predetermined strike (somewhat similar to methodology used in average rate and average strike options). So, for example, the lowest rate that existed during the life of the optimal option would be set as the *strike* for the optimal strike *call* option, or as the *put* rate for the optimal *rate* put option predetermined strike). The normal method is that of setting the strike which is the same as a lookback option.

In theory, there are great benefits in using lookback options as, for example, a company could guarantee to deal at the best rate that existed and keep the shareholders quiet! The problem is cost; a lookback option can be 100% more expensive than standard European options, depending on the volatility and maturity of the lookback, so buyers should be convinced that market volatility will be high enough to justify the cost.

A lookback straddle gives the buyer a hi-low option, enabling the purchase of a currency at the lowest rate and the sale at the highest; the payout being the difference between the two strikes. The buyer of a hi-low option

74 Reminder: FENICS is the option pricing software used extensively in the market for pricing most kinds of FX options, marketed by Inventure Ltd in the UK and Inventure Inc in the USA.

is betting that the future volatility of the market will be greater than the implied volatility of the lookback straddle. Such a strategy is akin to betting on every horse in the same race and hoping an 'outsider'[75] will win.

The lookback option receives much acclaim from theorists owing to its 'perfect' hedging qualities - always buying at the low or selling at the high (it has also been called the 'no regrets' option), but very few transactions actually take place owing to the high cost of the premium. Most corporates have premium reduction in mind (if granting some concession in the protection offered by the option, e.g. barrier options) than by premium increase for protection enhancement.

Lookback options are sometimes quoted against corporate interest but are very rarely transacted in the FX options market.

Basket options

Multinational corporations tend to have FX risk in many currency denominations. Hedging this risk can be achieved by the purchase of options in each currency or by the purchase of a single option to cover the whole 'basket' of currencies.

Basket options work in the same way as ordinary European options except that the strike price is based on the weighted value of each currency in relation to a buyer's specified currency (usually the accounting currency). For example, suppose a US dollar based company has currency balances currently valued at USD 10 000 000. An ATM (spot) basket put option would have a strike of USD 10 000 000; an OTM put would be USD 9 000 000, etc. On exercise, the buyer would have the option to sell (put) the basket of currencies and buy (call) the USD to the amount of the strike. Usually the intrinsic value of maturity is cash settled, rather than the currencies exchanged. The main advantage is that a basket of currencies will carry less volatility than the individual components, resulting in a lower premium for the basket option. The saving in premium cost will vary according to the composition of the basket and to the extent of any correlation between individual currencies, but savings of 25-35% are common.

The scenario is similar to that of the average rate option in the sense that premium reduction is achieved through grouping so that volatility is less. With average rates, the daily, weekly, or monthly options are added

75 In betting parlance, an outsider is one that has little probability of winning (i.e. only an outside chance), hence having high odds *against* winning – much the same principle as a low delta option.

together; in basket options, the currencies are added together. It is, however, possible to have an average rate basket option! The basket option is a very efficient method of controlling multi-currency risk if the buyer views all the different currency values as one, for example, a currency fund manager who has invested in various currencies, but reports performance on the total.

In other instances, basket options may not always provide the best solution. Imagine that a buyer bought ten individual options that resulted in six being OTM and four being ITM on expiry (assume also the basket option for the ten currencies was OTM on maturity). In the first case, the buyer could exercise the four ITM options and receive some value, whereas the basket option would yield zero. The question is whether the value received from exercising is greater than the difference in premium paid between the total of the ten options and the one basket.

Basket options should be more popular than is currently the case but, given the premium cost savings, many corporate customers are expected to enter the market in the future. It is mainly a matter of education.

CHAPTER

12

Using options for hedging: advanced

The early chapters of this book were devoted to explaining the option product and the four basic 'building blocks' of long call, long put, short call and short put. Chapter 7 (Using options for hedging: simple) showed how one could combine one or more of these basic vanilla options to design simple strategies that could be used for corporate hedging such as risk reversals, participating forwards and seagulls. Chapter 11 introduced the popular exotic options currently employed in the market-place, including higher risk types with discontinuous[76] payout profiles such as the reverse barrier. This chapter has two purposes:

1 To introduce a very special exotic option - the digital.
2 To look at strategies that are constructed using combinations of vanillas and exotic options.

We shall begin by looking at the digital option and its variations.

76 Reminder: vanilla options have continuous risk profiles (in one direction of FX rate movement) in that the return is dependent on the amount of intrinsic value present on maturity. The more the intrinsic value, the greater the worth of the option – in the case of a call, the higher the FX rate, the greater the payout. Some exotic options have discontinuous payout profiles. For example, increasing intrinsic value can be instantly lost should spot reach the predefined barrier level in a reverse knock-out barrier.

The digital (binary or bet) option

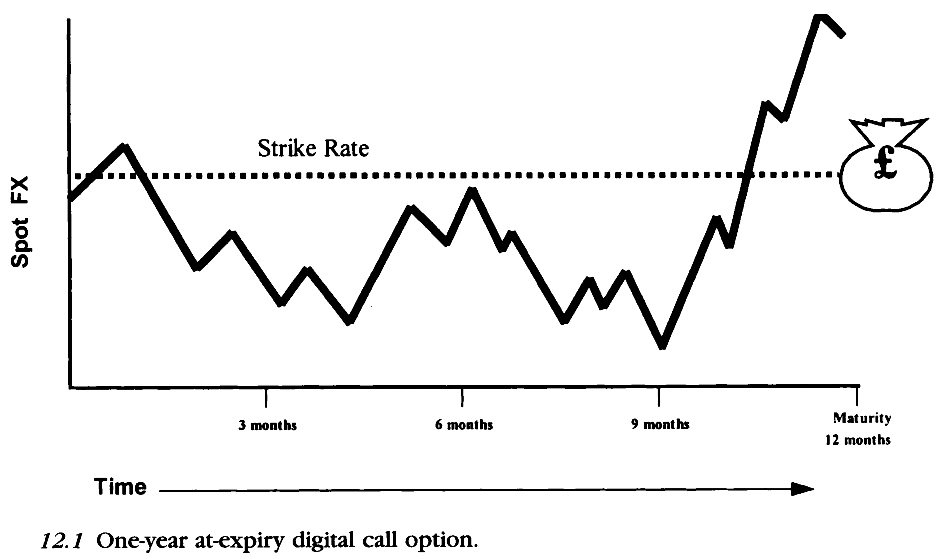
The buyer of a standard European-style option has loss limited to the premium paid, but profit potential is unlimited - a continuous payout profile - as the underlying spot rate has no boundaries, either up or down. In other words, maximum loss is known but maximum profit is unknown. The digital, binary or bet option changes this as the profit element is fixed to a predetermined amount. So, if the option is ITM on maturity, a fixed sum is paid irrespective of the apparent intrinsic value - a discontinuous payout profile.

This type of option can be defined as:

> At expiry, digital (sometimes called European digital) pays out a predetermined cash sum only if the option is ITM at expiry, i.e. the option can only be exercised at a set time, on the last day of its tenure.

This type of digital option is also sometimes referred to as an 'all or nothing' option; the buyer receives either the fixed amount or nothing, depending on whether the option is ITM at expiry. Figure 12.1 shows a digital call option that pays out a predetermined sum on maturity with spot finishing above the strike.

Because of the constricted payout profile, European or at-expiry digital options can be cheaper than the ordinary European options. They can be used to hedge FX risk, provided the fixed payout is sufficient to cover the underlying movement in the FX rate or when this amount is considered to be appropriate compensation for any level of spot. The problem with



12.1 One-year at-expiry digital call option.

hedging using a regular digital is that, by itself, the digital cannot fit the underlying continuous FX risk profile by its nature of being discontinuous through the fixed, predetermined payout amount. Nevertheless, the purchase of a digital option to cover FX risk exposure is far better than doing nothing at all.

Example:
A UK exporting company has income of USD 1 000 000 one year from now and is open to risk in the GBP/USD rate, rising where each dollar will translate into less GBP. The budget has been set at an exchange rate of GBP/USD 1.60.

To protect against the rise in GBP, the company could buy a vanilla GBP call (USD put) option for 3.2%, a premium of £20 000 ($1 000 000/1.60 × 0.032) but elects to purchase a digital option for same premium. The current spot rate is 1.60 so option is ATM spot. In this particular case, for a premium of £20 000 the digital will pay £50 000 if the GBP/USD rate is at any level above 1.60 on maturity.

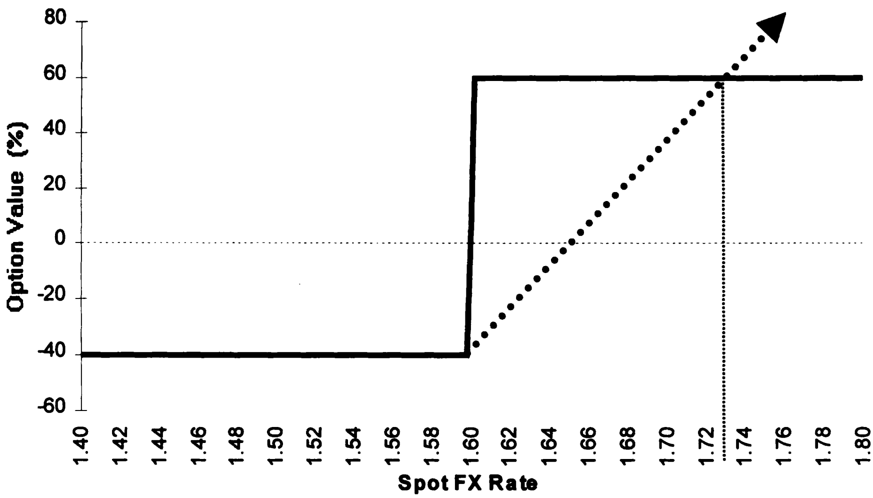
The purchase of the vanilla at 1.60 for a premium of £20 000 would provide full protection against any rise in GBP one year from now. The purchase of the digital at the same strike for the same term only provides £50 000 worth of protection - the equivalent of a GBP/USD rate of 1.7280 ($1 000 000 at strike = £625 000 × 0.1280 = $80 000 = £50 000) - but the company receives this amount at any rate above 1.60, even 1.6001.

Figure 12.2 shows the respective payout diagrams of the digital and vanilla options under this scenario. The vanilla is only better at rates above 1.7280 which may suit the corporate hedger who believes that the GBP/USD rate will not exceed this level at maturity. In exchange for giving up the full protection offered by the vanilla, the hedger receives a known fixed sum (£50 000) at all levels above the strike of 1.60.

Note the digital value on the Y-axis shown in Fig. 12.2 is expressed as a percentage of 100% of the predefined payout amount (in this example, £50 000). This is the normal method of quoting digital prices. So, for 40% maximum loss (£20 000 of £50 000), the digital option buyer has a maximum profit of 60-100% minus 40% - (£30 000 of £50 000).

Digitals for hedging

Digital options, as a specific class of exotics, are not usually employed to hedge FX risk (as in the example above) owing to the discontinuity aspect of the fixed payable amount but are frequently employed in advanced strategies designed especially for corporate hedging use. One of the common



12.2 One-year GBP 1.60 call (USD put) digital priced as 40% of £50 000 payout = £20 000. Payout profile of vanilla with same premium of £20 000 is also shown.

Note discontinuous payout profile of digital (thick line) compared to that of the continuous vanilla (dotted line). Y-axis shows digital option value as a percentage of payout of 100%.

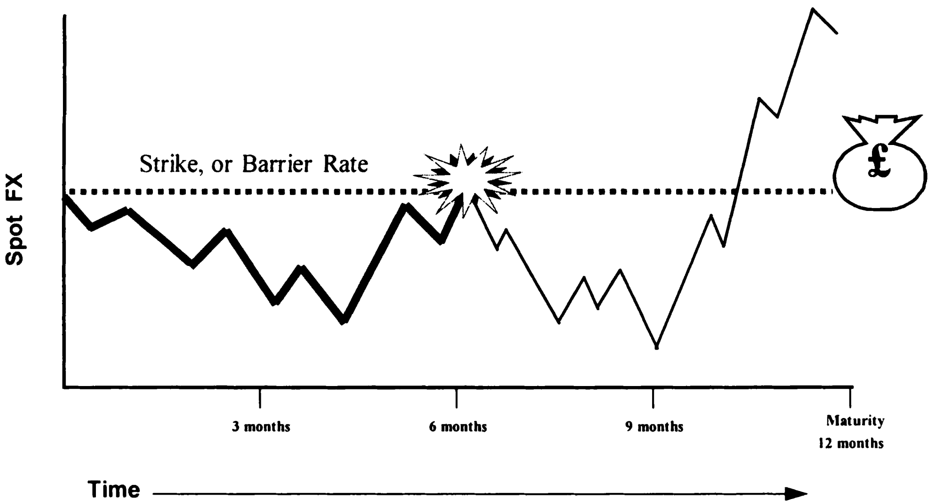
examples of this is the contingent option, which is a vanilla and digital combined that produce a strategy with no up-front premium. Before moving on to such strategies, we need to take a quick look at the different versions of digitals - all are speculative in nature (i.e. not hedging vehicles) - in order to fully appreciate the basic principle of 'fixed cost for fixed return' and install the idea of how this can be used as a tool to provide advanced hedging strategies.

Digital one-touch option

This is a path-dependent version of the 'at expiry' of digital. The one-touch pays out the predetermined cash sum at expiry provided the spot FX rate touches the strike at *any time* during the term of the option.

> A one-touch digital pays out a predetermined cash sum at expiry if it is in the money at any time during the term of the option.

The strike of the one-touch digital is sometimes referred to as the barrier and, indeed, the option acts like a knock-in barrier option, although the payout is a predetermined amount (at expiry) rather than the creation of a



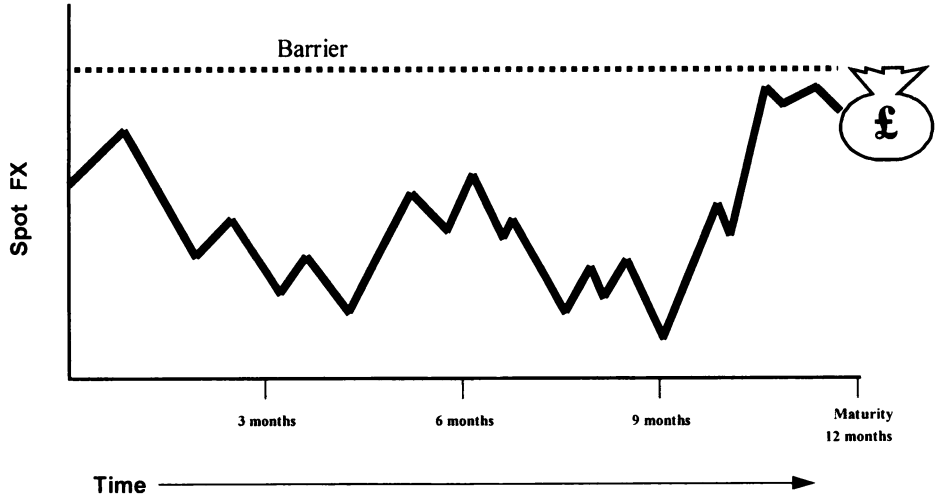
12.3 One-year one-touch digital call option.

vanilla option at a strike rate. In the absence of option creation, there is no need for a strike rate, hence the digital barrier. The call would be a digital up and in, and the put a digital down and in, option. In practice, the definition of calls and puts is sometimes dropped by using the very simple up and down statements. Figure 12.3 gives a picture of a digital up and in where the fixed cash sum at expiry is guaranteed when spot touches the strike (barrier) after about six months of the option's life.

Digital no-touch option

We can extend the idea of the path-dependent one-touch or digital barrier by having an option that pays out if the spot FX rate does *not* touch the barrier. This option is called a digital No-Touch and gives us the digital knock-outs. The call would be the digital up and out, the put the down and out (digital barrier). Figure 12.4 shows an up and out digital barrier that paid out a fixed, predetermined sum on maturity because spot failed to reach the barrier during the life of the one-year option.

The path-dependent one- and no-touch versions are used for speculative purposes and are more popular than the non-path-dependent at-expiry digital versions but are more expensive than the European digital version because of the increased chance that spot may touch, or not touch, the barrier at some point before maturity. For example, the one-touch is very roughly twice the price of the European digital option.



12.4 One-year no-touch digital (up and out digital barrier).

Digital instant one-touch option

A slight variation of the one-touch is the instant one-touch or American digital which pays the predetermined amount at the point when the spot FX rate touches the barrier (rather than at the original maturity date). This version is slightly more expensive than the one-touch digital by virtue of having the availability of funds at the point of barrier contact and is the most popular of all the digitals traded in the interbank market. Once again, it is not generally used for hedging purposes.

Digital option methodology

Digital options, whether they are European at-expiry or either of the two versions of one-touch, have very simple fixed cost (premium) and fixed payout elements which give rise to a very unusual aspect - there is no need for the option to have a principal amount. Exercise results in the payment of a fixed predetermined sum in just one currency, not in the exchange of currencies at the strike.

So, with digitals we can dispense with the strike (by calling it a barrier), dispense with calls and puts (we need only the direction - up or down - from spot) and there is no face value. We have effectively dispensed with the option altogether and have something that looks very similar to a straightforward bet.

In fact, the digital is often called a bet option and is identical to a wager, the only difference being that the jargon is different! Table 12.1 compares the digital with a bet on a horse.

Table 12.1 Comparison of digital with a bet on a horse.

Feature	Digital option	Bet
Fixed cost – when paid	Premium (up-front (spot))	Stake (up-front (now))
Fixed return – when paid	Payout on result	Winnings on result
Cost/return expression	In %	Odds
Pricing	Probability of event	Probability of event
Target for payout	Strike/barrier	Winning post
Risk	Loss of premium	Loss of stake
Purchaser	Buyer	Punter
Seller	Seller/writer	Bookmaker

The author of this book is certain that banks which write digital options do not consider themselves to be bookmakers and it is true that the hedging of these options can be quite different from that of a bookmaker. For example, bookmakers do not have the facility to delta hedge and readjust the delta during the running of a race (according to the position of the horse in the field of runners), whereas the option trader is able to deal in the spot/forward FX markets according to the probability of exercise.[77] Nevertheless, it is possible to adopt the bookmaker's method of trading with digital options and some banks do employ such methods.

Going back to the earlier example in Fig. 12.2, the digital call premium is quoted as a percentage of a 100% payout, which is the normal method of digital premium expression. So, if the buyer of the call option wanted a payout of £50 000, then the premium priced as 40% would be £20 000. The equivalent digital put would have to be priced as 60% giving a £30 000 premium for the £50 000 payout in order to achieve digital parity:

Long call @ 40% (£20 000) + long put @ 60% (£30 000) = 100% (£50 000)

Whatever happens to spot, the buyer of the digital straddle will have expended 100% (£50 000) to receive a guaranteed 100% (£50 000). In the real world, interest rate factors will alter the actual premiums to give a total that is less than 100% and an example of this is shown in the next section on digital pricing.

Although not generally seen in the market, the premium may also be quoted as a ratio in which case the above digital call price would be 40:60 (the put being 60:40) which has the convenience of giving the risk/reward parameters - the buyer of the call either suffers a loss of 40 *or* receives a *profit* of 60 (i.e. a return of 100, including premium). Bookmaker odds are *not* normally quoted for digitals, but it can be seen that odds of 6/4

77 Reminder: one definition of delta is the approximate probability of exercise.

against, apply to the example (win amount is one and a half times the stake).[78]

Digital pricing

The premium of the at expiry (European) digital is the percentage probability of the option being ITM *at expiry*. As the probability of exercise (i.e. being ITM at expiry) is one definition of delta, it follows that:

> *The spot delta of a vanilla option is the premium of the equivalent (at expiry) digital.*

In the earlier example, the GBP 1.60 call (USD put) premium is 40% for a payout of 100%. A vanilla option with the same strike of 1.60 would have a spot delta of 40%.

As there are only two factors in the digital (hence binary) option - premium and payout - and both are fixed, it follows that there is no difference in buying a call to that of selling a put,[79] other than the fact that the premium is paid (value spot) when buying, or received (value spot) when selling the option. As all option premiums are effectively discounted back from expiry at the fixed currency interest rate, there is no net difference in buying a digital call or selling the equivalent digital put as the Table 12.2 shows.

Table 12.2 Buying/selling a digital call/put.

Buy digital call	**%**	**Sell digital put**	**%**
Pay premium value spot	–40.0	Pay premium value spot	+54.3
Fixed funding cost @ 6% pa	–2.4	Fixed funding cost @ 6% pa	+3.3
Total cost at maturity	–42.4	Total cost at maturity	+57.6
Possible payout	+100.0	Possible payout	–100.0
Possible profit	+57.6	Possible loss	–42.4
Possible loss	–42.4	Possible profit	+57.6

At expiry to payout 100%, call premium 405, put premium 54.5%.

78 Betting odds are win/lose ratios, *not* total return. One unit staked would *win* one and a half units for a total return of two and a half units (the stake is returned in addition to the win amount). Another way to look at this is to say that odds of 6:4 represent four chances out of ten, hence six chances *against* four chances.

79 In a two horse race the punter (buyer) picks one horse to win, leaving the bookmaker (seller) effectively picking the other horse to win. Buying a call (backing one horse) is the same as selling a put (laying the other horse).

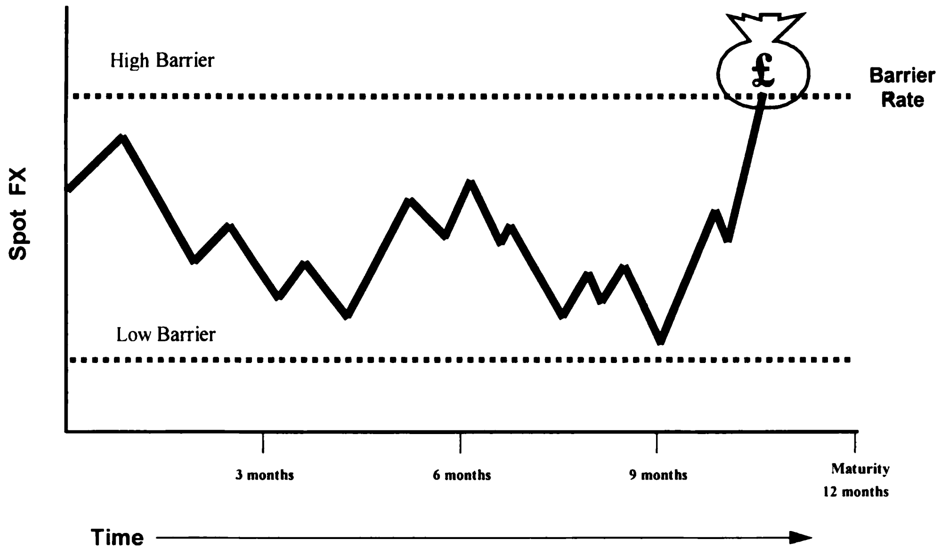
The pricing of path-dependent digital barrier types such as the one-touch is a completely different story. Here the probability of the spot FX rate touching the barrier (strike) before option expiry has to come into the equation, making the premium much higher than the at expiry type. As a very rough guide, the premium of an instant one-touch can be double that of an at expiry digital. The premium of a one-touch and a no-touch with the same barrier will, of course, add to 100% after allowing for funding on the premium at the given currency interest rate. Similar to reverse barriers, path-dependent digitals tend to trade in the market at levels above the theoretical value of the models used traditionally to price such options.

The bookmaker analogy has been used as this industry deals in betting - or what is known and accepted as betting - but there is another industry that deals exclusively in the digital methodology - the world of insurance - not FX but in other forms. For example, life insurance is nothing more than digital down and in barrier; if the life insured 'goes down' the digital option is knocked in and pays out the predetermined (insured) amount - the 'instant one-touch' variety!

There is very little real difference in the nature of digital options, betting and insurance except that they are applied in different industries using different regulations, different taxation and differing acceptability of the product. For example, in some countries, gambling is deemed illegal but digital options, being financial products, are not. Taking out an insurance policy is deemed to be a wise and good thing to do (and, in some cases like car insurance in the UK, compulsory) but betting is a sin. The difference is, of course, that one is a form of hedging (buying insurance is betting to win money on something one hopes not to happen) and the other speculation (betting to win money on something one wants to happen). There lies the difference, but the methodology is the same - digital options!

Double digitals

As with barriers, digitals can be constructed with two barriers. This gives 'range' positions in FX with fixed premium and fixed payout profiles and these are sometimes called range binaries. These are path-dependent options in the same manner as the one-touch or instant one-touch and, at first sight, appear to be a simple combination of a digital call and put at different strikes (a digital strangle?). However, this is *not* the case as range binaries carry the distinction of having *either* of the two barriers evoking (or not evoking in a double no-touch) one fixed payout. A one-touch digital call and put together would have two separate payouts - one at the top strike *and* one at the lower strike - giving the possibility of one or two payouts.



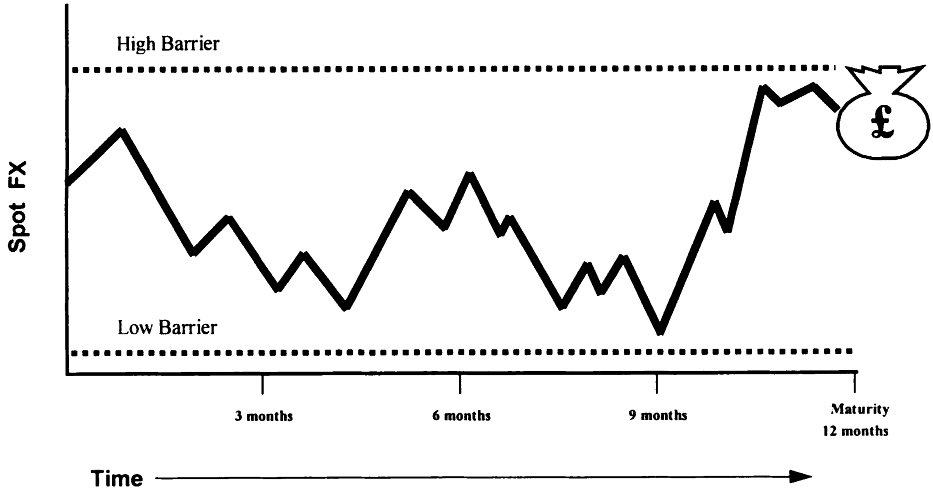
12.5 Double digital (range binary) double one-touch.

> A double digital is an option that pays out a fixed cash sum *either* if the spot FX rate touches one of two strikes (barrier) rates, *or* if spot remains within the range (i.e. between the two strikes).

Instead of calls and puts, double digitals are divided into those that pay out if either barrier is touched and those that pay out if the barriers are *not* touched. As either can be bought or sold, that gives us four types of digitals, except for the fact that *buying* a double one-touch has the same profile as that of *selling* a double no-touch[80] - the same effect as with single digitals whereby buying a put is the same as selling a call (see earlier part of this chapter). Another way of looking at this effect is to simply divide double digitals into those that pay-out if outside the range, as in Fig. 12.5, and those that pay-out if inside the range, as in Fig. 12.6.

Double digitals, like the single parent, are speculative in nature and are not used by themselves for general FX hedging purposes. They have been used for hedging *business risk* by banks in times of static exchange rates, such as that seen during part of 1996. Digitals are perfect instruments to provide revenue from 'nothing happening' - something impossible to achieve in spot foreign exchange. With the safety factor of a fixed potential loss, the interbank market saw the rise of the range binary during the quiet times and it is likely that these options were being used by banks and others

80 Except buying the option means paying the premium and selling is receiving the premium, hence this statement is true providing one ignores the interest cost/receipt aspects of the premium.



12.6 Double digital (range binary) double no-touch.

to hedge against the decline in FX revenue that goes with such markets. With increasing FX volatility, the range binary tends to decline in popularity.

Pricing of double digitals is based on the probability of *either* barrier being touched during the life of the option. As there is more chance of touching two barriers than one, one-touch double barriers carry higher premiums (and no-touch double barriers will be carrying lower premiums). Double digitals can be replicated through ***knock-out double*** barriers, as shown in Fig. 12.7 (long double no-touch/short double one-touch) and Fig. 12.8 (short double one-touch/short double no-touch).

Through very simple algebra, we get:

+DbKo call + DbKo put = +DNt = –DOt, and

–DbKo call + (–DbKo put) = +DOt = –DNt

Where '+' = long and '–' = short.

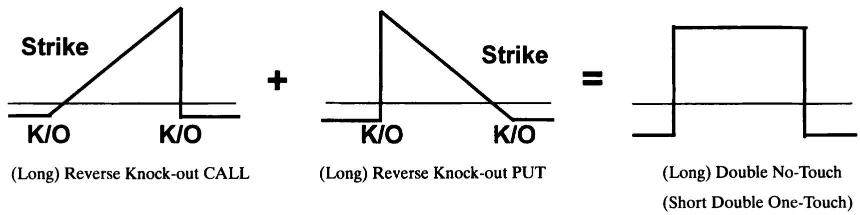
So, for example:

DbKo call = DNt –DbKo put

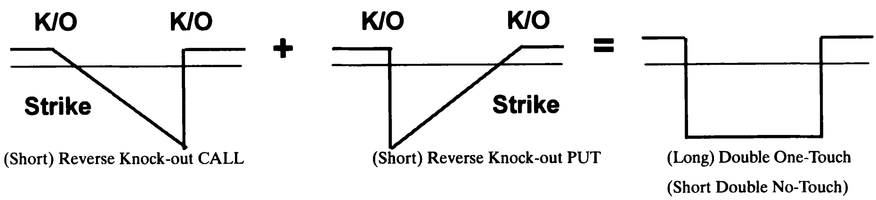
(Double knock-out call is equal to a long double no-touch digital and a short double knock-out put.)

Do not forget that we are ignoring the premium funding/income element in showing these relationships. In practice, the option prices will be automatically adjusted (through the pricing model) to take into account the interest on premiums - as with any option.

This relationship between double barriers and double digitals only works with double knock-out barriers where the discontinuous payout profile gives a limited loss/limited profit scenario in any outcome. Double



12.7 Long double knock-out call and long double knock-out put = a long digital no-touch (short digital one-touch).



12.8 Short double knock-out call and short double knock-out put = a long digital one-touch (short digital no-touch).

knock-in barriers have unlimited profit on long positions and unlimited possible loss on short positions.

We have now reached the point of demonstrating relationships between different classes of exotics and it is time to move on to looking at digital combinations.

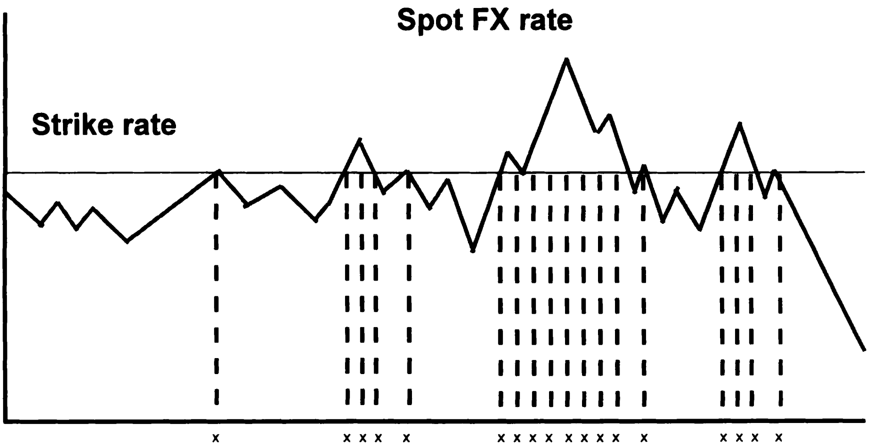
Digital combinations

Digitals have been used to create some interesting strategies, for example, a *daily digital* is an option that pays out a predetermined fixed cash sum at expiry for every day that the option is ITM. It is a series of at expiry digital options, one option expiring every day of the life of the daily digital. This gives a scenario of a variable payout with a maximum return of the daily payout times the number of days of the daily digital. Loss potential is limited to premium paid, as normal.

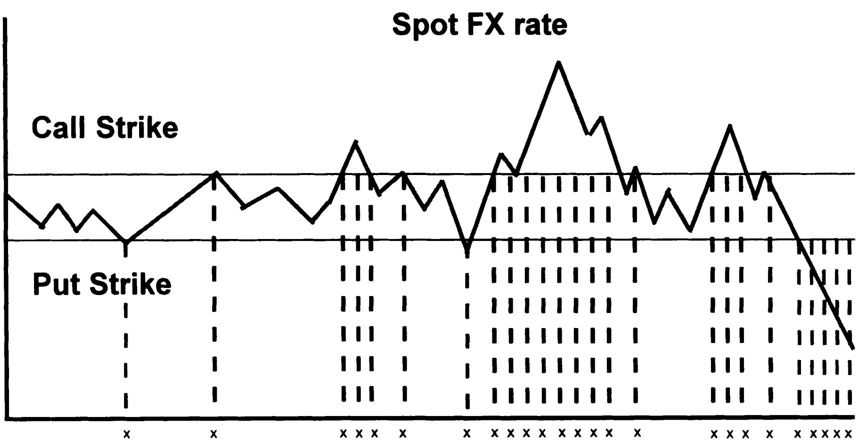
In Fig. 12.9, there are just 18 days where the digital would have paid out the agreed daily amount. Obviously, the total of this sum will have to exceed the premium in order to establish a profit. A total payment is usually made on maturity of the daily digital, rather than individual daily credits.

Although not designed with the corporate hedger in mind, the daily digital could be used to protect a specified level of spot on a daily basis and some corporate activity has been seen in this option product.

A *corridor* or *range accrual* option is an extension of the daily digital. This time the series is constructed with two daily at-expiry digitals – one call



12.9 Daily digital call option that pays a fixed amount for every day (x-axis) when in the money versus the spot rate (y-axis).



12.10 Corridor (range accrual) option that pays a fixed amount for each day (x-axis) when spot (y-axis) is out of the range.

and one put (rather than a call *or* a put) - resulting in a range through time. A corridor can be constructed to pay the total of the fixed daily sums on spot trading outside the range, or within. The total payment is, again, usually paid on maturity.

Figure 12.10 shows a corridor that pays out if spot is outside the range - either the call is ITM, or the put is ITM. In this example, there are 25 occasions where this occurred during the life of the option. Corridors are speculative in nature.

Other digital option products

To complete the list of digital options, another two are now discussed for completeness but are rarely transacted in the market-place.

Digitals with strike and barrier (digital barriers)

We can extend the digital family by combining the one-touch digital barrier with the principle of having both barrier and strike (standard knock-outs and knock-ins). With barriers, hitting the strike results in the instant creation (knock-in) or destruction (knock-out) of a plain vanilla option. With a digital strike and barrier, the knock-in results in an at expiry *digital*, the knock-out delivers the same, as long as spot does not touch the barrier. A knock-in option of this type would, therefore, pay out if the barrier was hit *and* the option finished ITM relative to the strike. Similarly, the knock-out would pay out if the barrier was not hit *and* the option expired ITM relative to spot.

As with barrier options, digital strike and barrier options (or just digital barriers)[81] can be of the reverse variety whereby the underlying at expiry digital is ITM relative to strike when the barrier is touched.

Similar to regular digitals, the premiums for digital barriers are quoted in a percentage for payout of 100% on the underlying at expiry digital. As already mentioned, these options are rarely traded in the market-place.

Double digitals with strike and barrier (double digital barriers)

The final step in the digital range is to add another barrier to the digital barrier and make it a double digital barrier. Similar to the double barrier, we now have two barriers, one up and one down plus a strike and with only the two types - knock-in and knock-out. The knock-in requires either of the barriers to be hit in order to create the underlying at expiry digital, the knock-out requires that neither barrier be touched in order to maintain the at expiry digital.

As with all digitals, double digital barriers are quoted as a percentage of a 100% payout on the underlying at expiry digital. These options are very rarely seen in the market.

81 It has been said earlier in this chapter that the digital one-touch is, in fact, a digital knock-in barrier. This is true only to the extent that a strike is not needed as the payout is contingent only on one event – that of the spot rate touching the barrier – i.e. the underlying is a fixed amount, payable on maturity. With the digital strike and barrier, the underlying is an at expiry digital, thus requiring *two* events to receive payout on maturity – one spot touching (knock-in) or not touching (knock-out) *and* the at expiry digital being ITM, on maturity.

Summary of digitals

The at expiry, one-touch, no-touch and instant one-touch varieties have followed closely behind barriers in the rise in exotic options. Indeed, the discontinuity aspect of both digitals and barriers means they can have similar properties - hence the relationship of reverse knock-out barriers and double digitals.

In times of static exchange rates, such as that seen during part of 1996, digitals are perfect instruments to provide revenue from 'nothing happening' - something impossible to achieve in spot foreign exchange. With the safety factor of a fixed potential loss, the market saw the rise of the range binary during the quiet times and it is likely that these options were being used by banks and others to hedge against the decline in FX revenue that goes with such markets. With increasing FX volatility, the range binary tends to decline in popularity.

Digitals are straight bets - normally the realm of bookmakers - as are most forms of insurance, the only difference being the underlying event risk. So we have banks betting on foreign exchange using digitals, bookmakers betting on all forms of sport using odds and insurance companies betting on all kinds of disasters using policies. As these are all essentially the same thing, the future will see the three industries merging through the arbitrage potential created by competition, lower transaction costs, uneven tax rules and regulation. There are already some overlaps, not so much in FX options, but between bookmakers and other sectors of finance and between bookmakers and insurance. For example, in the UK where gambling is legal, there are 'financial bookmakers' who will take bets on FX rates, stock indices and most of the exchange-traded instruments. Why buy shares involving broker commissions, transaction costs and taxes (e.g. stamp duty) when you can simply bet on the price? In the insurance markets, it is sometimes possible to get better odds through a bookmaker than the equivalent insured amount from an insurance policy.

This merging effect may cause problems in some countries where 'gambling' is considered illegal, unethical or disallowed for religious reasons. But one person's bet is the other person's hedge, so it would all seem to be a matter of perception. In the meantime, we can content ourselves that a digital is just another form of option and thus likely to be allowed the status of a financial derivative.

Exotic options in strategies

The digital option and some of the major variances have now been covered. This section is devoted to looking at some strategies that are combinations

of vanillas and exotics or combinations of exotics used for corporate hedging.

Contingent (pay later) options

A contingent option is merely a combination of an at expiry digital and a plain vanilla European option but, before describing the individual relationships, we will first look at the combined result as a structured transaction.[82]

Contingent, or pay-later, option premiums are only paid on exercise of the option. There is no initial payment and zero payment if the option is OTM on maturity. Does this look too good to be true? The drawback is that the buyer has an obligation to exercise if the option is ITM on maturity, regardless of whether there is sufficient intrinsic value to cover the premium.

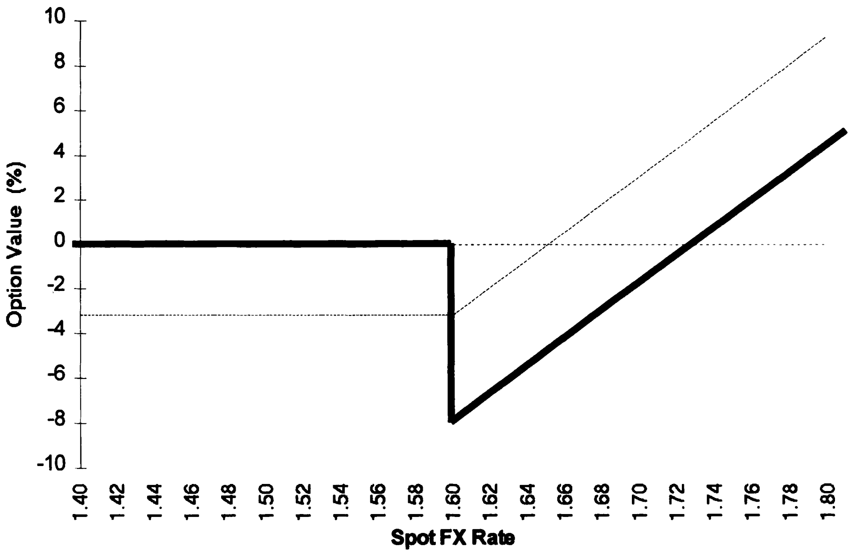
Contingent options are priced at the outset so the pay-later premium is known in advance, should the option be exercised. An ATM pay-later option is likely to cost more than double the equivalent ordinary European option, depending on strike, maturity and volatility. This difference in pricing implies expectation of a large one-way movement in the underlying FX rate for the buyer of a pay-later option. Nevertheless, many companies seeking protection against an adverse movement in the FX rate will feel comfortable that no premium is paid up-front and there is no cost at all should the option expire OTM. If this were the result, all the benefits from a favourable movement would be available, at no cost.

Figure 12.11 shows the payout profile of a one-year GBP call (USD put) contingent option compared with the familiar 'hockey stick' diagram of a plain vanilla call with same strike and maturity. The contingent, at 8%, is more than twice the cost of the vanilla, at 3.2%.

The example shown in Fig. 12.11 could be used as a hedge for a short GBP position (i.e. requiring protection from a FX rate increase against the USD). In this case, the hedger will benefit from no premium payment and will have all the benefits of an unhedged position, should rates decline below 1.60, by converting currency at a more advantageous rate. On the other hand, if the rate moves up against the hedger, he/she pays a large premium but is 'capped' to this as the total cost by exercise at the strike.

The idea of paying out a fixed predetermined sum if the option is ITM sounds a bit like the digital (at expiry) option described in the previous section. There are two differences:

82 Reminder: a structured transaction is usually a combination of different types of options or of options and other instruments that do not have a specific designation (name). They are normally constructed to meet specific customer requirements, often across more than one underlying market.



12.11 Contingent option GBP 1.60 call (USD put) for one year, premium 8% payable only if spot is at, or above, 1.60 on expiry. An equivalent plain vanilla call, premium 3.2% is also shown (thin line).

No up-front premium and whole structure is zero cost, providing spot is not above strike on option expiry when the very expensive premium of 8% is felt.

1 The contingent option delivers the currencies at the strike rate like a regular European option (the digital does not).
2 The digital has an initial premium similar to an ordinary European option (the contingent does not).

Given that the contingent option premium amount is predetermined, a digital option that pays out the same fixed amount can be bought if the option is ITM at expiry, and the same strike, amount and maturity date can be used. The following example demonstrates this:

Example:

1 Buy contingent 1.60 GBP call (USD put), one-year maturity, USD 1000000. Premium £50000 to be paid if spot above 1.60 on expiry.
2 Buy digital 1.60 GBP call (USD put), one-year maturity that pays fixed amount £50000 if spot above 1.60 on expiry. Premium 40% = £20000.

Result on maturity:
spot below 1.60:

1 No exercise, no premium paid, cost = zero.
2 No payout, premium already paid, cost = £20 000.

Net result: initial payment of £20 000.

Spot above 1.60:

1 Exercise of option, settlement of currencies, premium paid £50 000.
2 Fixed receipt of £50 000, no settlement of currencies, premium already paid £20 000.

Net result: settlement of currencies, fixed payments = zero, initial payment of £20 000.

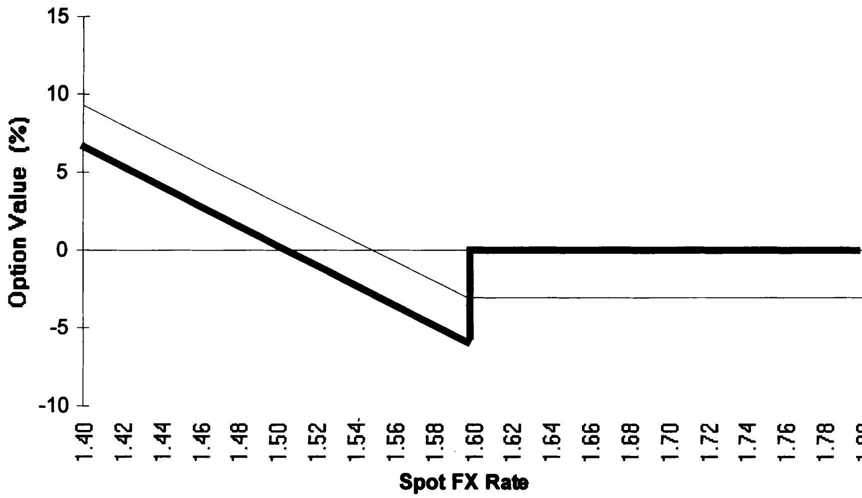
By looking at the two net results - below and above 1.60 strike level - the reader will note exactly the same circumstances exist as if an ordinary European 1.60 GBP call (USD put) had been bought with one-year maturity for a premium of £20 000. Therefore, there is a direct relationship between the at expiry digital and the contingent option, which can be simply expressed as:

Contingent option + at expiry digital option = plain vanilla

To put it another way, a contingent option is nothing more than the sum of a (sold) at expiry digital and plain vanilla option and illustrates the potential benefits of such combinations.

The buyer of a contingent only pays the premium if the option is ITM at expiry - this is the main feature of the product. However, take the earlier example of the hedger buying a contingent call option to protect against a rise in the underlying FX rate where a short GBP position exists (for example, an importer in the UK). The premium is paid at a time when the rate is going against the underlying position (GBP up). Would it not be better to pay the premium if the option was *out* of the money on expiry, i.e. when the FX rate is going in favour of the position (GBP down)? The premium cost could, in such circumstances, be reduced by the benefit of the underlying position. Although not deemed to be a true contingent option, such a strategy is easily constructed by using an at expiry put digital rather than a call:

1 Buy the plain vanilla one-year 1.60 GBP 625 000 call (USD 1 000 000 put) for 3.2% = £20 000 premium.
2 Sell at expiry 1.60 GBP put (USD call) digital at 54.3% (to pay out 100%) in order to receive £20 000 premium. Premium required now is 3.2% or £20 000 (to pay for 1 above) therefore digital payout is 5.89% or £36 832 if spot is at, or below, 1.60 at expiry (3.2%/54.3 × 100).



12.12 Long 1.60 GBP 625000 call (USD 1000000 put) for one year, premium 3.2% = –£20000; short at expiry digital 1.60 GBP put (USD call) for one year, premium receipt + £20000 being 54.3% for payout of 100% (£36832 or 5.89% of £625000); underlying position - short GBP (long USD) at 1.60. Equivalent of plain vanilla GBP call, premium 3.2% and short underlying FX = synthetic put[83], is also shown (broken line).

Zero cost if GBP above 1.60. Maximum cost of 5.89% just below 1.60 but reducing on declining GBP to break-even at 1.5057 (1.60 minus premium £36832 × 1.60/£625000 = 0.0943).

Now the hedger faces no cost if spot is 1.60 or above at expiry - he/she is fully hedged at this rate. Below 1.60, the digital payout of 5.89% is experienced but lessened by the underlying short GBP position at 1.60. Figure 12.12 shows the combined payout diagram.

In the example shown in Fig. 12.12, the net maximum cost comes out at 5.89% - a definite advantage over the 8% for the regular contingent in the previous example. This is because the digital put priced at 54.3% gives a payout of just £36832 against the £50000 in the contingent call example. This strategy has the advantage of being zero cost to the hedger at all rates above 1.60 where full cover is provided.

Barrier option with rebate

As mentioned in the last chapter, barrier options can be constructed with rebates. These predetermined fixed payments are made under the following circumstances:

83 Though put–call parity (Chapter 4), +call – FX = +put (long call and short FX is equal to long put).

1 Knock-outs - a rebate is paid if and when the trigger point is hit, cancelling the option.
2 Knock-ins - a rebate is paid on maturity, provided the trigger has not been hit during the option's life.

Barrier options with the rebate feature are more expensive in premium terms than those without because of the potential rebate. Rebate barriers are constructed through the purchase of a barrier option and a digital option; thus involving two premiums.

For example, using the option in Fig. 11.9 from the previous chapter, we have a down and out reverse barrier 1.60 GBP put (USD call) with trigger at 1.50 (ITM). The premium of this option is a tiny 0.12% or £750 for USD 1000000 ($1000000/1.60 = £625000 × 0.12%) and could be employed as a very risky strategy to hedge against a drop in the GBP/USD rate down to the knock-out level of 1.50. At this point all value attained - intrinsic value - would be lost, leaving the hedger worse off by some 1000 FX points, or £41667 (£625000 × 0.1/1.50). To mute the effect of the knock-out, the hedger could buy the same barrier but with a rebate of the potential lost intrinsic value of 1000 FX points, or £41667, should the 1.50 trigger rate be hit. The cost of the rebate barrier would be £25750 or 4.12% of the option's face value of USD 1000000 (GBP 625000 at 1.60) made up as follows:

	£premium	%
Long 1.60 GBP put reverse knock-out at 1.50	750	0.12
Long 1.50 one-touch digital to pay out £41 667	25000	4.00
	25750	4.12

Although the cost of the rebate barrier is far more expensive at 4.12% or £25750, this expense still compares favourably with the straight vanilla 1.60 GBP put (USD call) at 5.9% or £36875 for the USD 1000000 (GBP 625000) example. The comparison of risk between the rebate barrier and the vanilla shown in Table 12.3 is quite interesting:

In this example (Table 12.3), the hedger is better off with the rebate barrier where spot hits the 1.50 trigger and *subsequently reverses direction* and goes back up by the maturity date. In fact, at 1.60 and above (after touching 1.50) the rebate barrier provides an additional profit in that the rebate amount of £41667 covers the premium expenditure of £25750 to yield £15917 (2.55% of the option face value) *on top* of the value of the underlying long GBP (short USD) position beyond the point of 1.60 where the vanilla put is OTM. On the other hand, if spot stays below 1.50, the vanilla is better by virtue of the hedger having no cover from the rebate barrier

Table 12.3

Spot rate	Barrier touched?	Vanilla	Rebate barrier
1.60 and above	No	OTM	OTM
1.5001–1.6000	No	Intrinsic value	Intrinsic value
1.5000	Yes	Intrinsic value of 1000 FX points	Knocked out with rebate of 1000 points
Below 1.50	Yes	Intrinsic value of 1000 plus FX points	Cash, equivalent of 1000 points (£41 667)
1.50–1.60	Yes	Intrinsic value	Cash (£41 667)
1.60 and above	Yes	OTM	Cash (£41 667)

from that point (where the cash rebate has paid out 1000 points or £41 667). The hedger could, however, sell GBP (buy USD) in the forward FX market when the knock-out takes place at 1.50 to square all risk, although any forward discount of GBP would be against such action (with spot at 1.50, forward GBP/USD rate would be lower).

The risk comparison versus the cost saving has to be left to the buyer of the rebate barrier but it does offer an interesting scenario for corporate hedging. To recap, the rebate barrier option is not in an individual option class, but a combination of two exotics - a barrier and a digital (one-touch).

Bonus forward options

This is a combination of a vanilla and a barrier and comes under various names including break forward, forward extra and, in some cases, the word 'range' is included as in bonus range forward. It is basically an existing vanilla combination, such as the risk reversal, with the barrier feature added to one 'leg' [84]of the strategy. Bonus forwards, like their vanilla counterparts, are usually constructed at zero cost - the sale leg producing sufficient premium income to offset the purchased leg in a 1 : 1 ratio (same face value on each leg) - and are therefore used extensively for corporate hedging of FX risk.

For example, consider the following risk reversal:

1. Buy 1.60 GBP call (USD put), one year, for premium cost of 3.2%.
2. Sell 1.5154 GBP put (USD call), one year for premium receipt of 3.2%.

Net premium cost = 3.2% − 3.2% = zero.
Current market rates: spot GBP/USD 1.60; one-year forward 1.5552.

This risk reversal would be suitable as a hedge for a corporate with an underlying short GBP/USD position - maybe a UK exporter of goods priced in USD expecting receipt of USD 1000000 one year from now. Assuming goods have been budgeted using the current spot rate of GBP/USD 1.60, the bought GBP call - leg 1[84] of the above risk reversal - will provide 100% protection against a rise in GBP/USD. At rates below 1.60 down to 1.5154, the company will gain through the underlying short GBP (long USD) position but will be capped on further gains by the sale of the GBP put in leg 2 of the risk reversal. Figure 12.13 shows the graphic representation of this risk reversal.

So, there is full protection on the way up but limited profit on a favourable down movement. We can change the downside limitation aspect by adding a knock-out barrier to the sold GBP put, making leg 2 a down and out barrier option (a reverse barrier in this case) rather than a vanilla. In this way, leg 2 will disappear at the barrier level and give the seller - the corporate hedger - a windfall bonus equivalent to an uncovered position at that level.

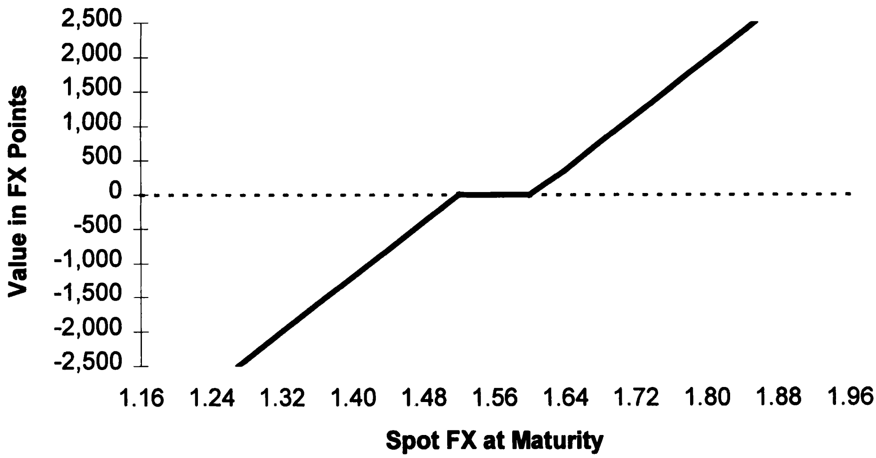
Using a barrier will reduce the premium receipt (a barrier is always cheaper than the equivalent vanilla),[85] thus incurring a net cost on the whole (the bonus forward) strategy, the amount of which is subject to the setting of the barrier rate. For example, if we add a trigger rate of 1.25 to leg 2 to make it a down and out reverse barrier, the premium receipt from selling this is some 1% less than the vanilla incurring a premium expenditure of \$10000 or £6250 for the \$1000000 strategy. To get back to zero cost, we could move the strike rate closer to 1.60 (i.e. higher) and/or move the barrier rate further away (lower) until such point where the premium is the same as the bought 1.60 GBP call (USD put). For the sake of the example, let's say we set the barrier at 1.25 and move the strike to 1.5552. At this point, the premiums are equal.

Figure 12.14 shows the payout diagram for this zero cost bonus forward.

If we combine the underlying short GBP (long USD) position using the budget rate of 1.60 (as against the actual market forward rate of 1.5552), we get a very favourable payout diagram as shown in Figure 12.15. This has been gained in part from accepting a higher strike on the GBP put (1.5552 instead of 1.5154) in order to meet the 1% premium receipt reduction caused by adding the 1.25 knock-out barrier.

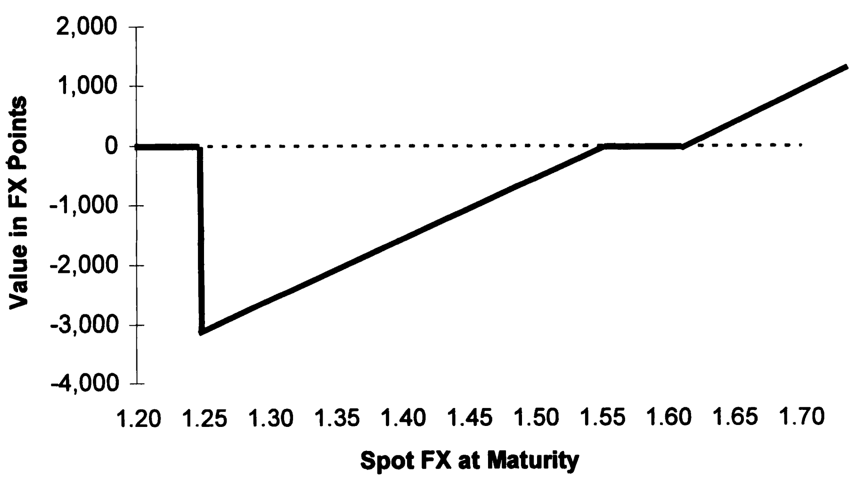
84 Reminder: leg is an individual option within a combination. Straddles, strangles, risk reversals and participating forwards are two-legged strategies. Butterflies, seagulls are three-legged, etc.

85 Reminder: a knock-out plus a knock-in barrier, with same strike and trigger, equals a vanilla (barrier parity). Therefore a barrier, be it a knock-in or a knock-out, has to be cheaper than the underlying vanilla.



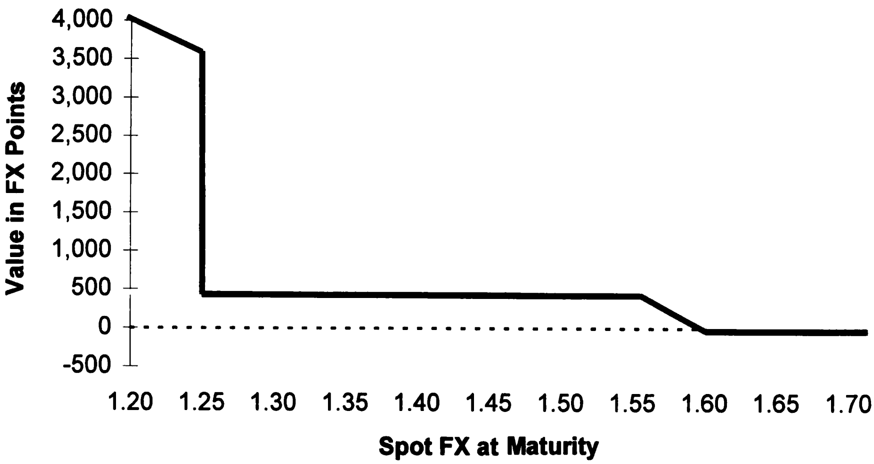
12.13 Long 1.60 GBP call (USD put), short 1.5154 GBP put (USD call); net premium zero. Current GBP/USD spot = 1.60. Forward rate = 1.5552.

Full cover is provided by the 1.60 GBP call shown by the profits above that level. The benefit of underlying short GBP position would be capped by the losses from the sold 1.5154 GBP put.



12.14 Long 1.60 GBP call (USD put); short 1.5552 GBP put (USD call) down and out 1.2500 reverse barrier; net premium zero. Current GBP/USD spot = 1.60. Forward rate = 1.5552.

All losses encountered from being short the 1.5552 GBP put are reversed on touching the 1.25 barrier level.



12.15 Bonus forward including underlying position budgeted at 1.60. Long 1.60 GBP call (USD put); short 1.5552 GBP put (USD call) down and out 1.2500 reverse barrier; net premium zero. Current spot = 1.60. Forward rate = 1.5552.

Adding the underlying short GBP position at budget rate of 1.60 (rather than forward of 1.5552) gives a 'no lose' scenario that benefits substantially if barrier of 1.25 is touched. All at no cost.

One note of caution – the windfall profits gained by virtue of the barrier knock-out could be reduced on any subsequent rise in the GBP/USD rate from 1.25. The hedger could, of course, lock in these profits by buying GBP (selling USD) in the forward market at the time of knock-out. With spot at 1.25, the forward will be at a lower rate, provided GBP interest rates continue to be higher than USD for the remaining term of the option.

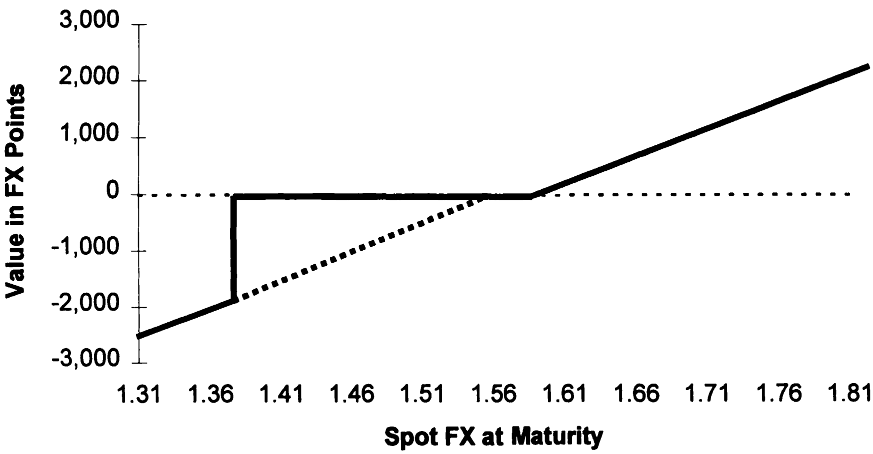
The bonus forward described above uses a knock-out barrier, but knock-in barriers can also provide very interesting payout profiles, as can be seen in the following example using the same strikes but with a different barrier level:

Buy 1.60 GBP call (USD put), one Year, for premium cost of 3.2%.

Sell 1.5552 GBP put (USD call) down and in 1.3700 barrier, one year for premium receipt of 3.2%.

Once again, for zero cost, full protection is offered at all rates above 1.60 for the corporate hedging against a rise in GBP/USD and, as before, profits will accrue from the underlying short GBP (long USD) down to the sold 1.5552 put strike, *if knocked in*. If spot never touches the 1.37 barrier, then profits will continue to accrue right down to that level. Figure 12.16 shows the payout diagram.

If we now add the underlying short GBP (long USD) position at the



12.16 Long 1.60 GBP call (USD put); short 1.5552 GBP put (USD call) down and in 1.3700 reverse barrier; net premium zero. Current GBP/USD spot = 1.60. Forward rate = 1.5552.

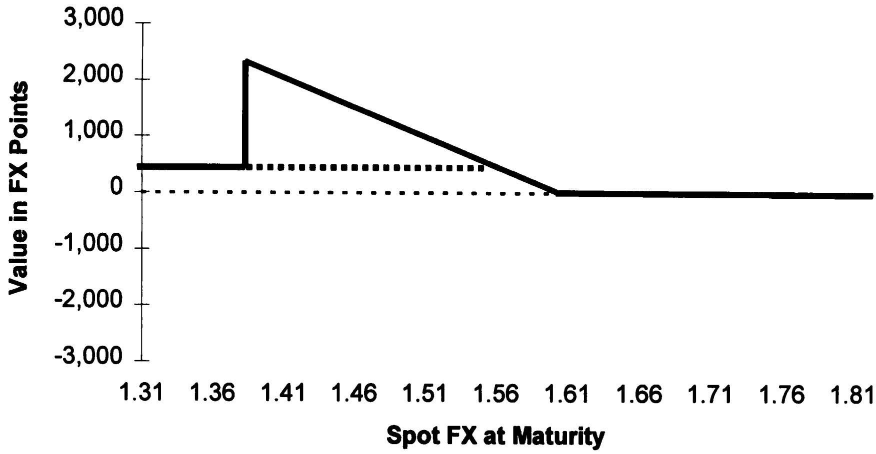
The profile of a zero cost vanilla 1.60 GBP call exists unless the put is created by spot declining to 1.37 when this profile is replaced by that of a 1.5552/1.60 risk reversal. The dotted line represents the intrinsic value of the put, if knocked in, declining if a subsequent rise in GBP/USD.

budget rate of 1.60 we get another attractive looking profile - no losses in sight, only profits. Like the previous example, this has been achieved by using the current spot rate of GBP/USD 1.6000 instead of the forward rate of 1.5552. In other words, a guaranteed profit against budget could be locked in by simply buying GBP forward at 1.5552 = 448 points profit. This amount has been given up by the corporate hedger for the opportunity of profits on a decline in the GBP/USD rate as reflected in the diagram in Fig. 12.17.

Summary

We have looked at using a digital option with a vanilla - the contingent, a digital option with a barrier option - the barrier rebate and a vanilla with a barrier - the bonus forward. All these option combinations can be used as hedging instruments by the corporate but, in the end, it all comes down to the amount of premium paid and the degree of risk/reward opportunities that are offered. It is hoped that the insight into how these strategies are created, and the risks involved, will assist the corporate hedger to understand what might be suitable for hedging FX risk.

Remember that exotic options - especially those that encompass some form of discontinuity - are priced at levels that can exceed or fall short of the Black-Scholes modelling.



12.17 Bonus forward including underlying position budgeted at 1.60. Long 1.60 GBP call (USD put); short 1.5552 GBP put (USD call) down and in 1.3700 reverse barrier; net premium zero. Current spot = 1.60. Forward rate = 1.5552.

Profits accrue below 1.60 until sold 1.552 put is knocked into existence at 1.37 at which point all intrinsic value is lost to the buyer but the risk reversal range profit of 448 points is retained (1.60 – 1.552). The dotted line shows profile if barrier knock in with subsequent rise in GBP/USD.

There are many other strategies available but it would be pointless to try to list them all here as new ones are constructed almost daily and old established varieties fade out of fashion. To finish this chapter, here are some recommended guidelines for consideration:

1 Banks tend to have their own names for the same strategy and there is a great deal of confusion in the market-place for what should be called what. So, if a bank offers a 'bonus swap', that seems to be what is listed in this book as a bonus forward, ask, 'Is this a bonus forward?' If in doubt, ask for a breakdown of the options used to construct the strategy.
2 Always ask for a risk matrix or payout diagram of the strategy performance over different levels of spot. Inclusion of one's own underlying risk position is recommended.
3 If you have the necessary software, try to recreate the strategy profile yourself - and check the pricing.
4 Always endeavour to understand how the component options (within a strategy) act to bring about the anticipated results. Use this book as a reference guide, if necessary.
5 Be very wary of strategies that propose no downside risk such as the two examples given in this chapter under 'Bonus forward options'. The payment has to be made somewhere - know where and how and remember there is never a free lunch.

6 Be wary of the word 'swap' in any strategy or option. This term is frequently used out of context and is becoming/has become associated with just about anything that involves derivatives. Originally a swap in FX markets was (and still is) a simultaneous purchase or sale value spot with a corresponding sale or purchase at a forward date - literally swapping currencies from one date to another. With the development of off balance sheet interest rate products in the late 1970s, swap is now generally perceived to be an interest rate swap - swapping interest cash flows - which is a mature and efficient market. ISDA (International Swap and Derivatives Association) terms and conditions are applied by most institutions but ISDA terms do not cover all instruments, especially exotics and exotic combinations. Calling something a 'swap' may be implying that such a product is covered under such terms.

CHAPTER

13

Risk control

All the risk profiles discussed so far have been on the basis of the option value at maturity for a given level of the spot FX rate at that time (plain vanilla options) or the value at interim stages should spot reach a specified level (exotics such as barriers and digitals). When using options to hedge specific amounts for specific dates, this is often all that is required in terms of risk control - a known payout that, when combined with the underlying position at a given rate, will produce a predetermined result for a specified level of spot. However, all options have interim values and such values may be important factors for the corporate hedger to consider.

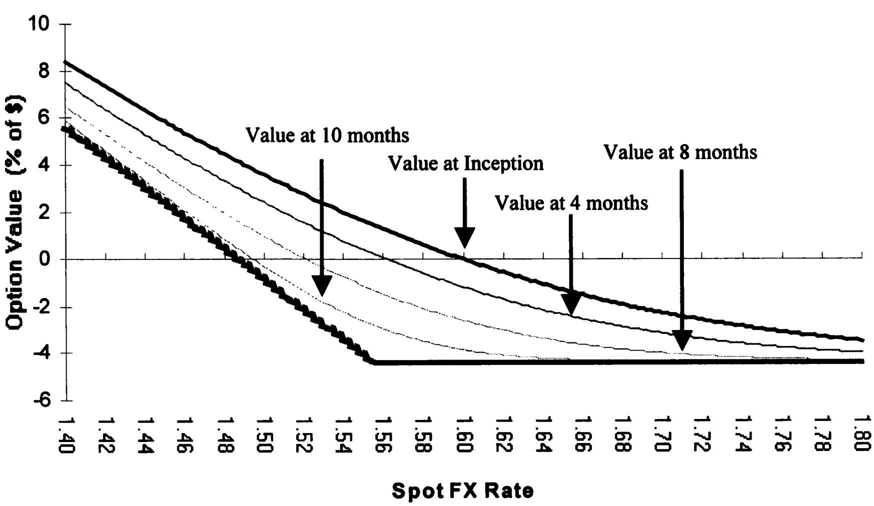
For example, consider the case of the UK exporter who has USD 1 000 000 receivable in one year from now who simply sells the USD forward (buys GBP) in the FX market. The company is fully hedged with a fixed conversion rate and all interim values of the combined position will result in zero (profits/losses on the hedge will be matched by losses/profits on the value of the USD 1 000 000 receivable). No risk control is required but what if the exporter used a vanilla bought GBP call option to hedge the receivable, instead of using the FX forward? The option will protect the company against GBP rising in the same way as the FX forward but will allow for profits (less the premium cost) on a fall in the GBP/USD FX rate - the basic principle of an option. This changes the risk profile dramatically and the reader will be familiar with the now famous hockey stick diagram of a long

synthetic put - the combined payout diagram of buying a call and being short the underlying FX position through put-call parity (long call + short FX = long put). But what is the payout diagram for the potential interim values of a long put?

Interim value of options

Interim value of options can be calculated at different levels of spot assuming no changes in traded volatility or interest rates for a given moment of time (i.e. value four months from now, eight months from now, etc). Figure 13.1 shows the payout diagram of a one-year synthetic 1.5552 GBP put (USD call) with the underlying short GBP position priced at current forward rate of 1.5552 to give the familiar hockey stick profile. Interim values have been added and are shown by the curved lines sitting above the straight maturity payout profile - the topmost is the interim value at inception (zero at 1.60); then after four months, after eight months and 10 months.

Looking at Fig. 13.1 and the top line - interim value at inception - one can see that the value of the combined position (synthetic GBP put option)



13.1 Combined payout diagram of long one-year ATMF - 1.5552 GBP call (USD put) with short underlying GBP at forward rate = synthetic GBP put, showing inception value and three other interim values.

The thick black line is the maturity payout or hockey stick profile. The higher value curved lines represent interim value at different moments in time during the option's life, at different spot levels.

is zero at 1.60 - the current spot level. This is because there has been no movement of time and no loss of option time value through theta (as shown in the other profiles at the same rate). Spot movement from the initial 1.60 changes the option value according to the delta at the specific level, which itself changes - the gamma - as spot moves away from the 1.60 strike rate. Thus we can discern three of the option Greeks from this diagram but note that vega is not present - the diagram is two-dimensional, showing profit/loss over spot and time.

Returning to the example, the UK exporter using the GBP call option to hedge the underlying short GBP position will experience interim profits and losses if the company were to revalue (mark-to-market) the two positions through time. Whilst losses can never exceed the premium paid, profits may accrue that might be better reflected in the profit and loss account over the interim period but this becomes an accounting decision. The point being made here is that there will be profit/loss fluctuations over time when using options to hedge FX positions and this aspect becomes even more important when the missing Greek - vega - is added to the picture in the next section on risk simulations.

Risk simulations

The example shown in Fig. 13.1 represented a combination of a bought 1.5552 GBP call (USD put) and a short underlying GBP FX position priced at the same (forward) rate. We can term these two positions as one 'portfolio' and run risk scans or simulations to gain a good measure of control over just what profit and loss expectations are embedded in such portfolios over a given time frame. Figure 13.1 is, in itself, a graphic representation of a risk simulation but is only looking at spot movement (delta and gamma) at various points in time.

Portfolio sensitivity to changes in the spot rate

Risk is normally viewed in the form of a matrix of profit/loss expectations over a given time frame - usually one day (i.e. the next day). Figure 13.2 depicts a simple spot sensitivity or spot ladder risk profile for the above portfolio in matrix form with results expressed in USD amounts. The current spot rate of GBP/USD 1.60 is moved up and down by the same degree - in this case by five cents in increments of one cent (100 points) - and results are shown in actual USD amounts.

FENICS 8.2 - [Position Report - Spot Ladder]

File Edit View Report Daily Tools Window Help

Spot Ladder	11:00 Thu 24 Jun 99	
Book	**Ccys**	**Horizon Days**
ATMF	GBP/USD	1 day
Spot	**Spot**	**Pos Profit Chg**
spot + .0500	1.6500	$ -14 330
spot + .0400	1.6400	$ -11 727
spot + .0300	1.6300	$ -9 000
spot + .0200	1.6200	$ -6 148
spot + .0100	1.6100	$ -3 169
spot	1.6000	$ -61
spot - .0100	1.5900	$ +3 178
spot - .0200	1.5800	$ +6 548
spot - .0300	1.5700	$ +10 050
spot - .0400	1.5600	$ +13 685
spot - .0500	1.5500	$ +17 452

13.2 Spot sensitivity matrix or spot ladder.

Matrix showing sensitivity of portfolio on movement of spot up and down from the current spot rate of GBP/USD 1.60 over the next day.

For example, given that no other factors change (e.g. traded volatility), the portfolio value will change by plus USD 3178 if spot moves down to 1.5900 overnight. Note that if spot itself is unchanged, there will be a small loss of $61 owing to theta (time decay). In other words, if nothing changes at all, then the portfolio will lose $61 in value by tomorrow.

As the example portfolio is a synthetic long GBP put (USD call), it can be seen that profits will accrue from a decline in the value of GBP/USD which, of course, is where the corporate hedger (the UK exporter) gains by virtue of being long USD (short GBP). If spot increases, losses are encountered but are found to be slightly lower in amount given the same degree of spot movement - owing to the limiting effect of the premium paid being the maximum possible loss on maturity (in this case GBP 28000 or USD 44800 for the ATMF GBP call). Unlimited profit potential, limited loss is a basic option fact.

Portfolio sensitivity to changes in spot and volatility

Option values - the premiums - are subject to change on movement in any of the underlying markets (spot, volatility and interest rates) and, of course, time. Spot and volatility are the most important, followed by time so we need to encapsulate vega into the spot sensitivity matrix. This is done by adding movement of traded volatility up and down (from the current rate) to show

FENICS 8.2 - [Position Report - Spot/Vol Grid]
File Edit View Report Daily Tools Window Help

Spot/Vol Grid | **11:08 Thu 24 Jun 99**

Book	Ccys	Horizon Days
ATMF	GBP/USD	1 day

		vol -2.00	vol -1.00	vol	vol +1.00	vol +2.00
spot + .0500	1.6500	$ -21 875	$ -18 117	$ -14 330	$ -10 521	$ -6 695
spot + .0400	1.6400	$ -19 363	$ -15 555	$ -11 727	$ -7 885	$ -4 032
spot + .0300	1.6300	$ -16 705	$ -12 858	$ -9 000	$ -5 135	$ -1 264
spot + .0200	1.6200	$ -13 896	$ -10 024	$ -6 148	$ -2 270	$ +1 611
spot + .0100	1.6100	$ -10 933	$ -7 051	$ -3 169	$ +713	$ +4 595
spot	1.6000	$ -7 814	$ -3 937	$ -61	$ +3 814	$ +7 688
spot - .0100	1.5900	$ -4 538	$ -680	$ +3 178	$ +7 036	$ +10 893
spot - .0200	1.5800	$ -1 102	$ +2 721	$ +6 548	$ +10 378	$ +14 210
spot - .0300	1.5700	$ +2 493	$ +6 266	$ +10 050	$ +13 842	$ +17 639
spot - .0400	1.5600	$ +6 247	$ +9 956	$ +13 685	$ +17 428	$ +21 182
spot - .0500	1.5500	$ +10 160	$ +13 791	$ +17 452	$ +21 136	$ +24 838

13.3 Spot and volatility matrix.

Matrix of spot and volatility movement over the next day with results in change of profit and loss expressed in USD.

the changes in option value across the different levels of spot. Figure 13.3 shows four extra columns to give the movement of traded volatility up and down by an absolute 1% and 2% from the current level. Note that the central column - no movement in volatility - is identical to the spot sensitivity matrix shown above.

Now we can see the projected overnight expectations given a movement in spot and volatility. For example, if spot declines to 1.5900 and traded volatility drops by an absolute 1% (say from 11.5–10.5%), the previous profit of $3178 (spot at 1.5900 but no move in volatility) has been reduced to a loss of $680. To put this another way, the profit from the drop in spot has been more than wiped out by (negative) vega.

Using Fig. 13.3 we can discern the following:

Table 13.1

Portfolio is *long* option	Profit if volatility increases	Positive vega
Portfolio is *long* option	Loss over one day if nothing changes	Negative theta
Not delta neutral	Profit in one direction, loss in other	Directional risk
Maximum profit	Given ±500 points in spot *and* ±2% absolute in volatility	USD 24838
Maximum loss	Given ±500 points in spot *and* ±2% absolute in volatility	USD 21 875

The final two points of maximum profit and loss are very valuable tools in risk management. Firstly, they give a perspective of the portfolio risk versus reward profile, overnight, for the chosen movements in spot and volatility. The example uses 500 points up and down in spot plus two percentage points up and down in volatility, but one can specify any range to fit individual expectations or reasonableness. Secondly, the maximum loss number gives us control over what losses might be acceptable (or not) - one can set a limit against this number. This is one of the elementary aspects of measuring and controlling risk under the now famous value at risk (VAR) principles.

Value at risk (VAR)

To get closer to measuring risk in VAR format, we need to recognise some aspects of risk matrices. For example, the maximum loss shown in Table 13.1 is \$21 875 and is located in the top left cell of Fig. 13.3 where we are looking at a spot of 1.65 and a reduction in volatility of two percentage points. This is natural as the portfolio is short the underlying GBP so will lose most on spot at the maximum of 1.65 and also, by virtue of being long vega, will lose the most by a drop of the maximum of two percentage points in volatility. However, we must look at the probability of those two events - spot up by 500 points and volatility lower by 2% - happening at the same time. In other words, if spot moved by that degree, is it feasible that traded volatility would drop? A move of 500 points in spot, in one day, is a very sharp jump and such would more likely increase the traded volatility rates than lower them. This is just logic.

The maximum profit number of \$24 838 is - quite logically - in the bottom right hand corner where the portfolio gains by both spot and volatility movement. However, such an event is far more probable than the maximum loss scenario mentioned above as a drop of 500 points in the spot GBP/USD rate would more than likely be accompanied by an increase in traded volatility.

It should be fairly obvious that some fine tuning is required to view risk in a more realistic manner. The first step is to view the spot movement in terms of standard deviations rather than absolute amounts. This will give us a mathematical probability of the likelihood of spot reaching the resultant levels overnight. To work out the standard deviation of the spot rate, we need the volatility factor for a one-day movement and the FX options market is very fortunate in that this number - the overnight volatility rate for a given currency pair - is traded and therefore readily available. Most FX options systems (such as FENICS) will have the facility to automatically produce the standard deviations of spot from the inputted market volatility rates.

Figure 13.4 shows the same portfolio as in Table 13.1 but this time the spot range is calculated out to three standard deviations, in 0.5 increments, from the current GBP/USD 1.60 level. This gives a magnitude of 1.5713 to

FENICS 8.2 - [Position Report - spotvolgrid(AH)]

File Edit View Report Daily Tools Window Help

spotvolgrid(AH) | 14:12 Thu 24 Jun 99

Book	Ccys	Horizon Days
ATMF	GBP/USD	1 day

		vol -2.00	vol -1.00	vol	vol +1.00	vol +2.00
spot + 3.00$	1.6291	$ -16 477	$ -12 627	$ -8 768	$ -4 901	$ -1 029
spot + 2.50$	1.6242	$ -15 114	$ -11 251	$ -7 382	$ -3 507	$ +370
spot + 2.00$	1.6194	$ -13 719	$ -9 846	$ -5 969	$ -2 090	$ +1 791
spot + 1.50$	1.6145	$ -12 291	$ -8 412	$ -4 531	$ -649	$ +3 233
spot + 1.00$	1.6096	$ -10 831	$ -6 949	$ -3 067	$ +815	$ +4 697
spot + 0.50$	1.6048	$ -9 339	$ -5 457	$ -1 577	$ +2 303	$ +6 182
spot	1.6000	$ -7 814	$ -3 937	$ -61	$ +3 814	$ +7 688
spot - 0.50$	1.5952	$ -6 258	$ -2 388	$ +1 481	$ +5 349	$ +9 216
spot - 1.00$	1.5904	$ -4 670	$ -811	$ +3 048	$ +6 906	$ +10 765
spot - 1.50$	1.5856	$ -3 050	$ +794	$ +4 640	$ +8 487	$ +12 334
spot - 2.00$	1.5808	$ -1 399	$ +2 428	$ +6 258	$ +10 091	$ +13 925
spot - 2.50$	1.5761	$ +284	$ +4 089	$ +7 901	$ +11 717	$ +15 536
spot - 3.00$	1.5713	$ +1 997	$ +5 778	$ +9 568	$ +13 366	$ +17 168

13.4 Spot and volatility matrix with spot range set by standard deviations.
The '$' sign in the first column represents standard deviation - e.g. 'spot + 3.00S' showing a rate of 1.6291 is 3 USD from spot.

1.6291 representing, mathematically, something like a 99% probability that spot will fall within this range over (in this case) a one-day time frame.

Note that the maximum profit and loss amounts are now $17 168 and $16 477 respectively and therefore somewhat lower than before in the arbitrary spot range of 1.5500–1.6500. Furthermore, we are now looking at risk numbers that will provide a 99% 'comfort' factor for maximum overnight profit/loss risk control.

Further requirements are possible. For example, we could change the volatility range to standard deviations in the same way as for spot, although this would require the volatility of traded volatility which is not available from the markets. One would have calculated the required number from a series of historical traded volatility figures.

VAR has developed over the years and is now well documented in various books available in the market-place.

Other risk measures

There are various other risk measurement techniques such as analysing the Greeks by maturity (gamma and vega 'buckets'), option maturity grids ('pin

risk') and others, but these are generally used in a trading environment whereby delta neutrality is the norm.

Software systems

A few words on software. To use options actively and to manage foreign exchange risk effectively, the corporate should consider a modest investment in an off the shelf system for it is difficult to analyse risk without some form of software. There are many available brand names but most have been designed for bank trading and are beyond the scope of the average corporate wishing to use options for hedging, and most are very expensive.

One should, at the minimum, invest in some form of pricing software such as FENICS which is the market standard for banks world-wide. FENICS products suite starts with a pricing module and extends through analysis to deal maintenance but does not encompass accounting. It is for this reason (lack of accounting) that FENICS is very much cost effective for the corporate using options. FENICS released a special low-cost corporate version in 1999.

If purchasing an off the shelf package is not considered, then the corporate should look at using a spreadsheet-based pricing tool, many of which are offered free by banks in the market-place.

CHAPTER

14

Documentation

Documentation covering option transactions for corporate clients of banks normally falls into the following categories:

1 Deal check - a quick recap of what has just been transacted, detailing key elements of the deal.
2 Written confirmation - legal document details all aspects of the transaction including the relevant terms and conditions governing. A signed response, agreeing details listed, is required.
3 Terms and conditions prevailing - ICOM, ISDA or individual (bank's own).

Corporate clients of banks will usually be subject to those terms and conditions dictated by the bank with which the corporate is dealing unless specifically requesting one of the internationally accepted forms - ICOM or ISDA.[86]

Many, indeed most, corporate clients of banks tend to give little consideration to documentation. This chapter goes into some detail on the ICOM terms and conditions and it gives a valuable insight into the importance of having appropriate documentation in place to cover option transactions. We shall start by looking at the history and development of documentation.

86 ICOM and ISDA are described below.

History of option terms and conditions

The reader will have observed in previous chapters that OTC market development was centred on London from the early 1980s. The Philadelphia Stock Exchange (PHLX) certainly provided the impetus in December 1982 when it listed the first currency option contract (GBP/USD, American style) but the OTC market grew out of the commitment of certain banks in London to quote each other two way prices (bid and offer) in 1984. In the same year, the Bank of England announced the reporting requirements for FX options, and OTC brokers were set up to service the fledgling market.

London interbank currency options market (LICOM) terms

One thing was still missing: a set of rules to reflect proper market practice with written terms and conditions to cover the legal aspects of OTC transactions. The British Bankers' Association (BBA) formed, in 1984, a working party to draw up the terms which resulted in the publication of LICOM terms and conditions in August 1985. Although intended to cover only the London market practices, LICOM soon became the standard for nearly all OTC contracts. In the USA, LICOM was more or less duplicated and published, in 1986, as New York interbank currency options market (NYICOM) which was later re-titled USICOM.

International currency options market (ICOM) terms

By 1989, it had become apparent that the original terms did not adequately reflect market practice which had developed into quoting in volatility terms with FX delta hedges. Furthermore, the number and diversity of market participants had increased substantially and was truly international. In May 1989 the BBA re-established a working party to collaborate with market interests, with a view to updating the 1985 terms and to provide guidance for market practice. In addition, emphasis was placed on the international acceptance of the revised terms hence the new title of ICOM. As with the LICOM working party, the Bank of England was represented as an observer on the ICOM working party.

At about the same time as ICOM was being addressed, a similar effort was underway in the United States to redraft USICOM terms. In 1990 representatives of the BBA working party for ICOM and the New York Foreign Exchange Committee for USICOM met to resolve the differences between the two sets of terms and to develop a single document for use in the international OTC FX options market. One aspect of the work done in New York

was to address the increasingly important issue of counterparty credit risk and, in particular, the rights and obligations of the parties upon non-performance, insolvency and *force majeure*. ICOM terms now provide a method for closing out and liquidating options upon the occurrence of one of these events. Furthermore, the document has been drafted in the form of a master agreement which reflects market practice with respect to the formation, exercise and settlement of options (including matters such as net cash settlement and automatic exercise) as well as setting forth the legal rights and obligations of the parties.

The New York committee comprised representatives from the legal departments of banks in the United States while the BBA working party was made up from senior trading managers of banks in London. This proved to be a very complementary fit. In addition, the BBA party embraced representatives of other countries, such as Japan, and appointed a member to look after brokers' interests.

In Japan, the Tokyo Foreign Exchange Market Practices Committee published ICOM terms in March 1993, in a similar manner to the New York Foreign Exchange Committee. The BBA has maintained full liaison with both.

Following publication of ICOM for FX options in London in 1992, a master agreement for spot and forward foreign exchange was drawn up and published by the BBA in 1993 under the title, *International Foreign Exchange Master Agreement* or IFEMA. Because FX markets are continually evolving, and because IFEMA reflected new thinking about certain issues, IFEMA differed in certain respects from the original 1992 ICOM. For that reason, ICOM was updated and issued as 1997 ICOM by the BBA in February 1997 and includes some important additions, such as the addition of barrier option definitions. It is this version, sometimes referred to as ICOM 2, that is outlined in this chapter and reproduced in Appendix IV. The IFEMA terms have themselves been updated through a 1997 release, and copies of this document can be obtained from the BBA, see Appendix IV.

The revision of ICOM terms prompted the issuance of a separate form of agreement that documents foreign exchange spot and forward transactions *and* foreign exchange options known as *the 1997 Foreign Exchange Options Master Agreement* or FEOMA. This is essentially ICOM and IFEMA together but issued as a master agreement rather than as terms (see summary below). FEOMA was issued in March 1997, one month after ICOM and at the same time as IFEMA.

The documents referred to here, ICOM, IFEMA and FEOMA, have all been produced under the auspices of the BBA in association with The Foreign Exchange Committee of New York, The Canadian Foreign Exchange Committee for Canadian Financial Institutions and The Tokyo Foreign Exchange Market Committee. These committees are all devoted to foreign exchange market practices and interests generally.

ICOM terms are reproduced in Appendix IV with the kind permission of the British Bankers' Association. Actual copies may be purchased from the association at the address shown on page 275.

International Swaps and Derivatives Association (ISDA)

Interest rate swap markets operate under terms and conditions issued by the International Swap Dealers' Association or ISDA. (The name has subsequently been changed to International Swaps and Derivatives Association Inc, but the acronym remains the same.) In 1992, FX and currency options definitions were published for use with ISDA master agreements. The currency option definitions are very similar to ICOM (ISDA acknowledge ICOM assistance in producing the 1992 definitions). In 1998, ISDA issued revised FX and currency option definitions intended for use in confirmations of individual transactions governed by the 1992 ISDA master agreements; FEOMA, IFEMA and ICOM; and other similar agreements.

Institutions have a choice of using either, or both, terms. The *1998 International Swaps and Derivatives Association (ISDA) FX and Currency Option Definitions* are available from the International Swaps and Derivatives Association Inc, see Appendix IV.

Market preference: terms and conditions

At the time of writing, banks and other institutions are using either IDSA terms and conditions or those of 1997 ICOM (which effectively replaces the 1992 ICOM) to cover their FX options businesses. ISDA terms are generally becoming more widespread in use. Both are considered legally binding documents supporting FX option transactions, with the provision of reduced credit risk through the netting of contracts in cases of default.

Master agreements: summary

To summarise the available documentation, we have:

The 1997 International Currency Options Market (ICOM)
These master agreement terms cover *foreign exchange options only*, but do include the most actively traded exotic option, barriers. A guide accompa-

nies the master agreement, which also includes market practice guidelines. Unless otherwise stated, banks trading FX options in London are deemed to have used these terms. This documentation is issued by the British Bankers' Association in London in association with The Foreign Exchange Committee of New York, The Canadian Foreign Exchange Committee for Canadian Financial Institutions, and The Tokyo Foreign Exchange Market Committee.

1997 International Foreign Exchange Market (IFEMA)
These master agreement terms cover *spot and forward foreign exchange only*. A guide accompanies the master agreement, which also includes market practice guidelines. Unless otherwise stated, banks trading spot and forward foreign exchange in London are deemed to have used these terms. This documentation is issued by the British Bankers' Association in London in association with The Foreign Exchange Committee of New York, The Canadian Foreign Exchange Committee for Canadian Financial Institutions, and The Tokyo Foreign Exchange Market Committee.

The 1997 Foreign Exchange Options Master Agreement
This is a master agreement (it does not include terms) covering *spot and forward foreign exchange and foreign exchange options*. This document is a master agreement, solely, and is intended to encompass ICOM and IFEMA for that purpose, i.e. banks may net FX and FX option exposures in event of default. As ICOM and IFEMA include market practice and are issued as the default terms, a separate guide has been deemed unnecessary for FEOMA. It is issued by the British Bankers' Association in London in association with The Foreign Exchange Committee of New York, The Canadian Foreign Exchange Committee for Canadian Financial Institutions, and The Tokyo Foreign Exchange Market Committee.

1998 International Swaps and Derivatives Association (ISDA) FX and Currency Options Definitions
Issued as 'definitions' these form part of the ISDA Master Agreement for Swaps (i.e. interest rate swaps). As such, ISDA may be used for *interest rate swaps, foreign exchange and foreign exchange options*. The currency option definitions are very similar to ICOM but have specified currencies listed (ICOM allows for all currencies) and they do not carry FX options market practice guidelines.

1997 international currency options market (ICOM) terms

We will now concentrate on the latest ICOM document as this can be used as the backbone of the terms and conditions and market practice for all

master agreements for FX options. An insight into ICOM and its translation will provide the reader with a good understanding of those matters that need to be addressed by the corporate user of options.

Although ICOM is confined to practices in the interbank and professional markets and is not directly concerned with the terms and conditions upon which individual banks may choose to deal with their clients, ICOM could be used for such circumstances. Banks and other professional market participants are free to use other terms or agreements if they so wish, but should consider themselves under an obligation to make clear to each other in what way their terms differ from ICOM. In this way, ICOM will always form the basis of the market and be considered the norm for OTC FX option transactions.

1997 ICOM has a total of 13 sections but if we exclude the introduction, disclaimer, comment and order forms and the various examples (all of which are included in Appendix IV) we have four sections:

1 Guide to The Master Agreement

This has an introduction and sections on market practice and master agreement provisions. The market practice section is commented on below. The master agreement provisions provide an explanation and guide to the actual legal document - The Master Agreement (see 2 below).

2 The actual Master Agreement terms

The Master Agreement stands on its own as a legal document and some banks may wish to record their entry into a master agreement on ICOM terms in hard copy by signing with each, or some, of its counterparties. The Master Agreement provisions (in 1 above) provide explanations of the terms so the author has not commented further in this respect.

3 Schedule of 'Certain matters to be agreed'

This section covers matters where each bank must determine such items as scope of the agreement, designated offices, notices (addresses, telephone numbers, contact names, etc), payment instructions, netting, automatic exercise, base currency, threshold amount, additional events of default, automatic termination, adequate assurances, governing law, consent to jurisdiction, agent for service of process, certain regulatory representations and any additional covenants. Commentary is provided on this section below.

4 The barrier option addendum

Following the expansion of FX options trading in barriers, definitions have been included as an addendum. Items defined are barrier option, barrier determination agent, barrier period, exercise time window, initial spot rate, in strike price, knock-in event, knock-in option, knock-out event, knock-out option, out strike price, spot exchange rate, and spot market. Responsibilities of notification of knock-in/out event, exercise and settlement and discharge and termination of barrier options are also included in this section. Once again, commentary has been provided on this section below.

The market practice section of the guide (see 1 above) is reproduced here (except for the introduction) for comment and to complement Chapter 9 (Market practice):

Market practice

Price quotation

'There are two generally accepted methods of price quotation: premium and volatility. In each case, the counterparties shall agree upon:

Option style (American or European),
Call currency and amount,
Put currency and amount,
Expiration date,
Expiration time,
Premium payment date,
Settlement date,
Strike price.

Counterparties should also agree upon whether they are entering into a contemporaneous foreign exchange transaction (commonly known as a delta hedge).'

In practice, traders very rarely state the option style, as American is not generally used in the interbank market, leaving European style as the default. Premium payment date is not specified before the quote is made, but is included if a deal is concluded, along with payment instructions, etc (see example, Chapter 9). Delta hedge is taken as automatically included on volatility quotes unless specified (rare) or quote is for a delta-neutral combination of options (straddle or strangle).

'Price quotation should be in the form of either:

(a) A premium, where the counterparties agree upon the above terms and on how the premium price should be expressed, e.g. as a per-

centage of either currency or as one currency in terms of the other (it is also necessary to agree upon a spot rate in the case of a premium quotation where a delta hedge forms part of the trade); or

(b) Volatility, where the counterparties agree upon the above terms and that the volatility be expressed as a percentage per annum. It is this factor which, when combined with the spot rate, interest factors of the currency pair concerned, the days to expiry of the option and the strike price, is used to compute the premium.'

If premium price quotation is requested, it is normally on a 'live'[87] basis - without a delta hedge - and expressed as a percentage of the underlying, except for the currency pair GBP/USD where US cents per GBP is the normal method.

Exceptions occur in countries that do not use USD as their base currency, in which case currency units per USD is the normal method. Premium quotation is not the norm among market professionals but is still used by corporate users and some smaller banks that have not yet invested in option pricing systems (if a bank has a FX department, it is better to deal volatility with delta hedge thereby gaining the foreign exchange element of the transaction).

> 'An option is not a legally binding contract until, among other things, the premium has been agreed (The Master Agreement contemplates, however, that an option is a legally binding contract before the premium is *paid*.). Therefore, to ensure the ongoing viability of the volatility method of dealing, it is incumbent on the counterparties to agree on the premium price as soon as possible, and it is imperative that the calculation of the premium accurately reflects the agreed volatility and market conditions at the time volatility was agreed. In the event of a dispute that cannot be resolved between the counterparties through good faith negotiation (or, in the first instance, by reference to recordings of conversations between the parties during which pricing was discussed), prompt reference to mutually acceptable third-party arbitration is suggested. Market participants should note that, as premium calculation differences are more likely to occur in transactions involving American-style options, due care should be exercised in entering into such options.'

87 Reminder: a live quote is one where the option marker maker is open to changes in the option premium owing to movement in the spot FX rate. In other words, there is no delta hedge transaction with the counterparty, which would otherwise negate the initial spot risk. Banks active in FX options, including all market makers, quote in volatility with simultaneous delta hedge hence live transactions are usually those with non-bank counterparties such as corporations and customers.

Volatility quoting in very busy markets sometimes takes the form of banks agreeing on the volatility price and spot reference for the delta but agreeing premium at a later time when markets might be more quiet, hence the statement regarding the legality of this.

Disputes over premium differences are rare as most market professionals simply 'meet in the middle'. As spot and volatility rates are pre-set, disputes can only arise from the other factors in an options price: the forward FX rate, and interest rates. If these are also agreed, then differences are down to the option-pricing model. It should be noted that, at the time of writing, Inventure Ltd's FENICS option pricing system is the current standard of the market-place, and a bank not agreeing premium from a volatility quote should refer to this system through a third party, such as a broker, as a basis to resolve disputes.

It should be further noted that FENICS has a facility to price options according to the time of day - a clock - which if switched on may produce a different premium for the same volatility rate than if switched off (the pricing model splits time into days and fractions of days, instead of just days). The market standard is to calculate premiums with the FENICS clock switched off; any adjustment required owing to the length of day remaining should be made to the volatility quote in the first place.

Pricing American-style options produces many differences across different systems, partly explaining the decline in the popularity of this style (the main reason is that an American-style option can never be cheaper than the European-style one). Differences tend to occur when the two currency interest rates are similar.

> 'In addition, when trading volatility, it is necessary that a spot rate be agreed upon by the counterparties immediately upon entering into the option. This forms the basis of the underlying foreign exchange transaction (delta hedge), if any.'

This is normal market practice for volatility quoting and it is very rare to trade from a volatility quote without the delta hedge (unless it is a delta-neutral composite transaction such as a straddle or strangle, in which case delta is close to zero).

Quotation of expiration dates

'Generally, there are two methods for quotation of expiration dates: quotation of straight expiration dates and quotation of expiration dates by calendar month.'

Straight expiration dates

> 'An option quoted for straight periods (such as one month, two months, etc) has its final expiration date on the date preceding the equivalent forward date (as dealt in the interdealer foreign exchange market) that will result in settlement on the forward date, if it is exercised on the expiration date. If there is more than one solution, the furthest date from the trade date will be the expiration date.
>
> *Example:*
>
> Today's date: 4 March
> Spot date: 6 March
> One-month FX date: 6 April
>
> The expiration date for a one-month option quoted on 4 March will be that date which will result in a settlement date of 6 April, i.e. 4 April (assuming no weekends or holidays between). To avoid misunderstanding, in the case of periods under one month, it is recommended that the parties refer to an actual date.'

This is relatively straightforward, although there are occasions - such as holiday periods - when it is difficult to calculate the option expiration date. If, having agreed an expiration date, it subsequently transpires to fall on a holiday, the contract stands on those agreed dates unless both parties agree to amend (usually by changing original premium value). Periods of under one month should be specified by actual date, not one week, ten days, etc, because it is possible for the forward FX market to be quoting the period of say one week as eight days owing to holiday. Despite this recommendation, option market practice is still to call the short periods of under one month as 'days to maturity from today' e.g. 'what is one week GBP/USD volatility?' meaning 'option to mature this time next week', whereas the rule above might produce a period of eight days, i.e. spot one week is eight days, resulting in option expiration of the same period. Care should be taken at all times.

Expiration dates by calendar month

> 'Currently, it is market practice to quote for expiration in a particular month without reference to the actual date. In these circumstances, it is generally understood that the expiration date of the option is the Monday before the third Wednesday of that particular month.'

FX options, in common with those of other markets, sometimes trade expiry dates that coincide with the futures delivery dates of the international monetary market (IMM) contracts on the Chicago Mercantile Exchange (CME). IMM delivery is on the third Wednesday of March, June, September and

December hence OTC option expiry is for the Monday before the Wednesday in order that any exercise of the OTC option would result in delivery on the Wednesday (spot delivery - two days). The Philadelphia Stock Exchange (PHLX) currency option contracts also trade for other months that deliver on the third Wednesday, hence the OTC practice extends to cover all months of the year.

Notwithstanding the above practice, the majority of OTC transactions are for fixed periods to maturity - one month, one week, one day, etc, rather than for specific dates in the future.

Expiration on non-business days

> 'Although the Master Agreement does not provide that the expiration date must be a business day (i.e. a local banking day for the office of the seller that has written the option), this will customarily be the case. However, some dealers regularly sell options with expiration dates that are not local banking days for their applicable designated office. (Similarly, some dealers will accept notice of exercise on a non-business day.) If the expiration date is not a local banking day for the seller's designated office (or if the seller is not willing to accept notice of exercise at its designated office on a non-business day), it is incumbent upon the seller to make other arrangements (such as designating a different office or an agent for receipt) to enable the buyer to exercise its option. In these circumstances, the seller should notify the buyer of such arrangements as soon as possible and reconfirm them to the buyer prior to the expiration date.'

Options are frequently traded for expiry on dates that are local bank holidays. The most important holidays that restrict trading are generally those of the USA and, to a lesser extent, those of the UK, Germany and Japan. Many of the international banks have traders working on local bank holidays so exercise of options maturing is no problem. Even those banks that do not work on local bank holidays can easily arrange for exercise through overseas branches.

Confirmations

> 'The significant terms of an option should always be established by the parties at the time the option is entered into. The agreement of the parties on those terms will be set forth in the confirmation. However, there may be matters relating to an option that are not required to be set forth in the confirmation. Market participants are encouraged to include information as to such matters in the 'Other terms and conditions' section of the confirmation. The definition of confirmation provides that a con-

> firmation may contain other matters that the parties may specify in a confirmation. That may be particularly necessary for exotic types of option, such as barrier options.'

Confirmations play a very important role in the OTC market as there is no central clearing house (as on the exchanges) to match each bought and sold contract. This opening paragraph in ICOM is simply stating that traders and brokers should be mindful that their dealings should always be in accordance with market practice and anything 'unusual' should be stated at the beginning when obtaining quotes, etc, and, if the trade is concluded, then the pertinent details should be added to the regular confirmation under the category 'Other terms and conditions'.

> 'As in the cash spot and forward currency markets, the prompt exchange of confirmations (preferably electronically) and their immediate and thorough checking upon receipt (and querying where necessary) is vital to the orderly functioning of the marketplace, as well as providing a principal defence against many types of fraud. The option markets are more complex than the cash markets because of the greater number of parameters that need to be specified for each transaction and the different types of options that might be transacted. This additional complexity reinforces the requirement for confirmations to be issued promptly. Confirmations with respect to options often contain terms other than the economic terms of the option. Instead of the parties exchanging confirmations, it is common for one party to send a confirmation for the counter-signature of the other party. It is suggested that brokers also send to the counter-parties confirmations of any options which they arrange. If there has been a misunderstanding between the parties as to the option terms, this will usually be discovered upon review of the confirmation or confirmations. The non-receipt of an expected confirmation or any inconsistencies or inaccuracies should be queried or objected to within the time period recognised by local market practice.'

Confirmation issue, the checking of those received and follow-up of those not received, is paramount to the reduction in misunderstandings which occur in OTC options. ICOM has attempted to address the problem of misunderstandings by reiterating the importance of 'immediate and thorough checking upon receipt', and by recommending electronic exchange of confirmations (rather than the mailed version).

To this day, the most persistent error that occurs is the recording of a call instead of a put (and vice versa) which, if missed at the confirmation checking stage, will only come to light on the expiration date when one party will believe the option is out of the money. This type of misunderstanding is

sometimes missed at the confirmation checking stage because one party is referring to a call on one currency in a pair, whilst the other party is referring to a call on the countercurrency.

> 'A recommended form of confirmation is included as an example appended to this guide. Market participants (including brokers) are encouraged to follow the format and terminology suggested in order to reduce the risk of misunderstandings.'

If all OTC market participants were to adopt the recommended format for confirmations, then checking would be made very much easier and the kind of misunderstanding mentioned above (call instead of put) would have a better chance of being spotted.

> 'Market participants frequently enter into a contemporaneous delta hedge at the time they enter into an option (either with the option counterparts or a third party). It is market practice (and market participants are encouraged) to separately confirm such transactions. In addition, it is suggested that brokers send confirmations of any delta hedges which they arrange to the parties involved.'

Delta hedges are usually confirmed as separate FX transactions but with a notation of 'Ref FX option' or something similar. Brokers usually confirm the delta hedge, along with the option confirmation, on telex, and issue written confirmations separately.

It is worth noting that many errors are discovered by reference to the delta hedge. For example, in the call–put problem mentioned previously, the delta would have been constructed as a buy instead of a sell (or vice versa), resulting in incorrect payments of currency. As most hedges are done spot, the misunderstanding is detected within two days.

> 'Finally, market participants should indicate at the beginning of negotiations and prior to entering into an option, in which way their dealings and the formation, exercise or settlement of the relevant option will differ from the established market practice. Similarly, brokers should be mindful of, and adhere to, market practice with respect to the formation of options and their dealings with option counterparties (including the issuance of confirmations in the recommended form).'

The whole procedure of confirmation issue, receipt and non-receipt varies a great deal in the market-place. Generally speaking, banks should place more emphasis on the subject and invest in bringing their systems and procedures up to date. All too often, confirmation checking is left to junior staff and is mostly done by the 'eyeball' method; the clerk visually ticks one record

against the other. The success of this method is down to the individual performing the task. A better way to check confirmations and tract non-receipt, etc, is by secondary input, i.e. the clerk enters all details provided by the counterparty's confirmation into a computer which does a comparison check with the current database, showing any differences immediately. The computer could also then track transactions where no comparison has yet been made to highlight non-receipts.

Confirmations should also be issued electronically (e.g. through SWIFT) rather than mailed. In addition to the written confirmation, many banks are now doing verbal deal checks over the telephone on the day of the transaction as a better (and much quicker) method of locating potential errors. This check can be done at the same time as swapping instructions for delivery of premiums, value dates, etc.

Schedule of 'Certain matters to be agreed'

There follows an outline of the schedule, which asks for the following:

Part I: Scope of the agreement
Many banks deal in many different centres. This section is to specify which or all of the offices or branches are included under the Master Agreement.

Part II: Designated offices
Details are given of each party's designated office.

Part III: Notices
Details are given of each party's address, telephone number, telex number, facsimile number and name of individual or department to whom or to which 'Notices' should be sent for the purposes of the agreement.

Part IV: Payment instructions
Details are given in relation to the party's instructions for payment of currencies or use of standard settlement instructions (SSIs).[88]

Part V: Netting
This allows for counterparties to specify whether Section 4 (Discharge of options), Section 6.1 (Netting of premiums) and Section 6.2 (Netting of other

88 SSIs are usually bilateral arrangements between banks for currency payment instructions. For example, Bank A in London will instruct counterparties to the effect that all USD payments for Bank A's account should be made to XYZ bank, New York, Account no 999999, chips id 111111, etc, *unless otherwise advised.*

amounts) of the Master Agreement shall apply, or not. Some banks do not have the system capabilities to handle netting in all instances.

Part VI: Automatic exercise of options
This allows each counterparty, if the buyer of an option, to specify whether automatic exercise of ITM options is to apply, or not. In the original 1992 ICOM, automatic exercise was introduced as a facility to prevent large sums of intrinsic value being potentially withheld by the option seller for what might be technical reasons e.g. a communications fault that prevented the buyer contacting the seller before the specified expiry time. Automatic exercise only applies to those options that have intrinsic value of 1%, or more.

Part VII: Base currency
Notification of each counterparty's base currency for the purposes of the agreement.

Part VII: Threshold amount
For the purposes of clause (x) of the definition of event of default, each counterparty may specify its threshold amount.

Part IX: Additional events of default
Three potential events of default are listed in order that banks may signify which, or all, constitute such.

Part X: Automatic termination
This allows each counterparty to specify whether the automatic termination provision of Section 8.1 (Close out and liquidation) is to apply, or not.

Part XI: Adequate assurances
This allows each counterparty to specify whether the adequate assurance provision of Section 11.14 (Close out and liquidation) is to apply, or not. This section only applies to the New York version of the Master Agreement as Section 11.14 does not appear in the BBA release of the 1997 ICOM in the UK.

Part XII: Governing law
This allows for the selection of applicable law of the State of New York, England and Wales or Japan.

Part XIII: Consent to jurisdiction
Each party submits to the courts of the State of New York, the courts of England or the Tokyo District courts.

Part XIV: Agent for service of process
This allows appointment of an agent for service of process in any proceedings, or can be not applicable, if desired.

Part XV: Certain regulatory representations
This allows for banks to state whether certain Federal Deposit Insurance Corporation Improvement Act (FDICIA) representations should apply.

Part XVI: Additional covenants
Any additional covenants are to be entered here.

The barrier option addendum

This addition to the original 1992 ICOM terms should be welcomed in the market-place because it addresses several issues that have caused problems and confusion in the past as barrier options have grown in popularity. This is especially true for the reverse type barriers[89] where large intrinsic amounts may be at risk as spot approaches the barrier, or trigger, level. Chapter 11 outlines some of these problems under the section 'Barrier options', sub-section 'Determination of spot touching barrier' (see p 172). If the reader is unfamiliar with barrier options, it would be advantageous to read the section on this exotic option in Chapter 12 before proceeding.

The 1997 ICOM expects the parties to a barrier option to name the barrier determination agent which may be either the buyer or the seller of such an option. Market practice is usually to nominate the market maker – the bank that provided the price on which the deal was transacted, sometimes called the 'non-aggressor'. In the case of a bank dealing with a customer rather than another bank, then the bank is usually the determination agent as a customer would not be in a position to have the required access to FX spot markets.

It is the responsibility of the barrier determination agent to determine whether a barrier has been breached, which determination must be made 'in good faith and in a commercially reasonable manner'. This statement opens up the issues that have caused problems in the past and ICOM makes some specific recommendations of which the following represents a summary:

1 *There must be actual transactions in the FX markets* for a barrier to be breached. Quotations, even firm dealing rates, do not constitute the triggering of a barrier option.
2 Transactions known to be *off market do not count.*

89 A reverse barrier is that where the option is knocked in, or out, as the intrinsic value is increasing. Reverse barriers are described in detail in Chapter 11.

3 *Spot FX* transactions in the FX market must take place *between 6.00 am Sydney on Monday and 5.00 pm New York time on Friday*. Transactions outside these hours do not count, even if there is an active market (for example, owing to some particular world event).
4 *Transactions must be of commercial size* - that which is generally accepted by FX dealers for the applicable currency. Parties may agree, in the case of larger barrier option transactions, to specify a larger amount.
5 *Spot FX* transactions *that result in the barrier being breached may include those of the barrier determination agent* with third parties, but not with affiliates or other parties who are not dealing at arm's length or otherwise are not providing good faith fair market prices.

The reminder of the barrier addendum is dedicated to giving recommendations of good practice and covers the following points:

1 *What triggers a barrier event?* The barrier event occurs if the spot FX rate is equal to, or beyond, the barrier rate.
2 *Initial spot rate* which is the spot rate at the time of the barrier transaction. Banks should include the initial spot rate on all barrier confirmations, as it can be helpful for potential dispute resolution and for risk management purposes.
3 *Evidence of barrier being breached* - the barrier determination agent is required to inform the other party of a barrier event occurring. If requested to do so, the determination agent should provide evidence of the trade which caused the event (i.e. the spot FX deal). Such evidence may include a taped telephone conversation, a printout of a trading screen (e.g. Reuters Dealing System) and may include evidence provided by the counterparty to this spot deal. If there is a dispute between the parties over whether a barrier has indeed been breached it does not affect the validity of the barrier determination agent's action in determining the spot trigger, unless the agent's reassessment of the available price information results in it being no longer able to conclude such trigger action (i.e. the barrier determination agent may change the decision through reassessment in cases of dispute).
4 *Exercise of knock-out options* - knock-in barrier options may be either American- or European-style, but knock-out options must be European-style. Such barrier options (European) may be exercised only on the expiration date *at* the expiration time, provided that no knock-out event has occurred prior to the time of exercise. In other

words, one cannot exercise a knock-out barrier option as a way of avoiding a potential barrier event (knock-out) before the option expires. If such notice is given, then it is on the basis that exchange of currencies will only take place if the spot FX rate does not breach the barrier rate between exercise and the expiration time on the expiration date. To get around this problem, ICOM allows for a facility to exercise during an exercise window, provided that this facility has been chosen by both parties. The exercise window is one hour prior to the expiration time and any exercise during this period is deemed to be final, irrespective of whether a barrier event occurs following such an exercise. The exercise window is sometimes considered to be desirable for operational reasons.

5 *Cross rates* - spot FX rate includes cross rates, which are determined from two other FX rates. If the parties to a barrier option do not wish cross rates to be used to determine if a barrier has been breached (but instead use only actual trades in the relevant currencies), then it will be necessary to note such in the confirmation. As with barrier determination generally, a party using one or more cross rates to determine if a barrier has been breached must comply with a standard of good faith and in a commercially reasonable manner.

6 *Offsetting transactions* - unless otherwise agreed, a purchase and sale of identical barrier options will not be offset.

7 *Disclosure of fact* that a barrier option party may be active in hedging its barrier option position in the FX market to the point where such hedging activity may increase the probability that a knock-in or knock-out event will occur. A bank will generally hedge its barrier option positions by buying or selling a quantity of the relevant currency, and may adjust its hedge as market conditions change during the life of the option. Such hedging and de-hedging activity may affect spot prices and therefore affect the probability of a barrier being touched.

Impact of 1997 ICOM

The 1997 ICOM Master Agreement terms have been produced by and are recommended by the Foreign Exchange Working Party of the British Bankers' Association in conjunction with the Foreign Exchange Committee of New York and The Tokyo Market Practices Committee. These terms replace the previous ICOM terms produced in August 1992 and, from the beginning of 1997, any currency option entered into on the London market will be

assumed to be on the basis of these terms, unless otherwise agreed prior to dealing. Banks are free to deal on other terms if they so wish, but should make clear to their counterpart in what way such terms might differ from those of the 1997 ICOM.

The FX options markets continue to evolve and it is expected that those exotic options that are not included in this version of ICOM (for example, digital options) will form the basis of further addenda in the future. In the meantime, the new ICOM terms will help give a stronger legal backing to a fast expanding market.

CHAPTER

15

Counterparty credit risk

Many companies may decide that entering into FX and option contracts with one's own bank does not warrant any consideration with regard to the possibility of default by the bank - counterparty credit risk. However, every bank will require a credit line for each of its corporate customers and it is well to know of the risks involved. Banks are frequently reluctant to advance credit lines where the margins (potential benefit) of such are not fixed in advance. For example, a straightforward loan from a bank will carry some form of margin or spread over a known benchmark - LIBOR plus 1%, base plus 2%, etc. In this way the bank can guarantee a return which is a return for the credit (default) risk in advancing the loan - risk for reward.

With foreign exchange and FX options there is no such benchmark and credit facilities take the form of a credit line that is applied against the corporate option transactions that are presently current (open or 'live'). There is no margin and no known return for taking the credit risk. This chapter attempts to explain how banks assess options' counterparty risk and the methods employed to value and control such.

Background

One benefit of trading on the listed markets is that the counterparty credit risk is absorbed by the relevant exchange or clearing house. This benefit is

paid for in the cost of maintaining margin payments and the administration of such, which can be very time consuming. Nevertheless, the margin system does work very well and few institutions worry over the credit aspects of dealing on the exchanges. Consequently, this chapter examines the credit issues as applied to the OTC market but, before we address option counterparty credit risk, we must first look at the system employed by the FX market for spot and forward transactions.

In the 1998 Bank for International Settlements (BIS) survey, the daily volume in foreign exchange was recorded as the equivalent of some 1.5 trillion (1500 billion) US dollars. This volume is transacted between banks worldwide without the use of one single clearing house – it is truly 'over the counter'. The FX market has seen continued growth for some years with options estimated at the time of writing to form about 90 billion US dollars a day. In the absence of a clearing house, each FX market participant has to make and receive payment of principal on an individual basis and each transaction is open to counterparty credit risk. Every deal has a payment of one currency and a receipt of another, often in currencies other than a bank's own domestic currency. For example, a bank in Germany trading the USD against the JPY will have to pay and receive currencies through accounts in New York and Tokyo. As currencies are exchanged on the same day (the value date), a bank is at risk in that the purchased currency may not be received after the sold currency is paid. This risk is recognised as settlement risk and banks apply credit lines (i.e. lines of credit) to each and every counterparty, including a bank's own customers.

Foreign exchange limits

Credit lines for FX vary between institutions but are generally in one or more of the following forms:

Maximum outstanding limit (credit line)

The maximum outstanding limit is applied to the total of outstanding FX contracts by face value (usually converted to a base currency, either USD or the accounting currency for the institution concerned). This limit prohibits the build up of transactions with one particular counterparty. Some institutions segregate currency purchases from sales and place a limit on the higher of the two.

Maximum daily delivery risk (MDDR) or settlement risk

The maximum daily delivery limit, or settlement limit, is a restriction usually forming a percentage of the maximum outstanding limit, and attempts to control the accumulation of risk on any one day. For example, a bank with FX contracts outstanding for USD 100 million for delivery on one day is more at risk than the bank with a similar amount but with delivery spread across different dates, because default of one payment would suspend the following payment pending receipt of the first (or inquiry into breach of contract, etc).

Revaluation, mark-to-market, or market replacement cost limit

Calculating the contract replacement cost is a very valuable aid in assessing true FX counterparty risk. Each transaction with one counterparty is assessed on the basis of the cost that would arise if the bank concerned were to replace a contract in the market-place. The result ought to show the risk should the counterparty enter bankruptcy before the delivery date of the foreign exchange. This form of credit control is very different from the maximum outstanding and maximum daily delivery limits which are only concerned with the exchange of payments on delivery, i.e. the full face value amount. It is not concerned with whether to do so is beneficial (profit against current spot rate) or not (debit against spot rate). The revaluation method measures the possible loss impact on non-performance by the counterparty in not delivering on maturity of the contract. The limit is thus set in terms of maximum revaluation loss amounts, not face value amounts. The loss limit is very similar in profile to that of an unsecured loan to the counterparty; the most that can be lost, in case of default, is the amount advanced (plus interest).

Example:
Outstanding FX contract: buy GBP 10 000 000 at GBP/USD 1.60, value six months from now. Current six months forward rate: 1.65.
Delivery risk: GBP 10 000 000 USD (16 000 000)
Mark-to-market at 1.65: USD (16 500 000)
Market replacement cost: USD (500 000)

In this example, the institution is expecting to buy GBP 10 million at the rate of 1.60 USD per pound and thereby sell USD 16 million, six months from now. The applicable credit limit for delivery is the face value amount of GBP 10 000 000 (or USD 16 000 000). However, if the counterparty were to become bankrupt within the next six months, the delivery limit would become irrelevant but the institution would be left to replace the contract

in the market-place at the new rate of 1.65, thereby locking in a loss of USD half million.

It can be seen that, in this example, the loss of USD half million is only a small percentage (3.125%) of the contract face value of USD 16 million and represents the degree of movement in the forward rate from 1.60 to 1.65. Obviously, the movements in FX can be very much larger than this and the tenure of the contract will play a significant part in the probability of such movement; a spot transaction of two days will carry less risk than one of six months.

Of course, this method of credit control is only applied to negative consequences of FX rate movement. A positive move in FX would leave the institution in a profitable position, i.e. the market replacement cost would be lower than the outstanding contract. In the example above, let us assume the USD/GBP rate declined to 1.55. The position would be:

Delivery risk: GBP 10 000 000 USD (16 000 000)
Mark-to-market at 1.55: USD (15 500 000)
Market replacement benefit: USD 500 000

Of course, in practice the institution would not actually benefit from the transaction as the USD half million would be claimed by the creditors of the bankrupt counterparty but, nevertheless, no loss would occur.

Netting

There are two netting concepts: close-out netting and payment netting. Both reduce counterparty credit exposure but are essentially unrelated.

Close-out netting

Close-out netting is a contingent right affecting unmatured trades, whereby an institution is allowed to close out (terminate or liquidate) all the outstanding transactions with a defaulting counterparty, and to protect against 'cherry picking'[90] in the event of bankruptcy or liquidation of such counter-

90 Cherry picking is the term often applied to the process whereby a bankrupt company's assets and liabilities are divided and sorted. The liquidator picks the good ones (those in credit) and ignores the bad ones (those in debit), irrespective of the fact that the counterparty to a credit and debit may be the same person.

party. Close-out netting agreements for FX options are usually constructed as master agreements between one institution and another on a multi-branch basis similar to the ICOM Master Agreement for FX options.

A close-out netting agreement reduces potential post-default increases in credit exposure by permitting close-out of all unmatured trades upon default. It also reduces current credit exposure by protecting against cherry picking, thus reducing exposure to the net rather than the gross ITM value when there are both ITM and OTM transactions with the counterparty.

A close-out netting agreement will reduce an institution's internally allocated capital requirements but is not yet recognised for regulatory risk-based capital requirements.

There are potential balance sheet benefits from close-out netting agreements. For example, in the USA under FASB 105, an institution will report net (rather than gross) ITM amounts per counterparty (or zero, if net ITM is a credit - see example for revaluation limit).

Payment netting

Payment netting is a routine operational act applied to transactions as they mature. All payments with the same currency arising from trades with the same value date are paid on a net (or combined) basis. For logistical reasons, most payment netting agreements are constructed on a bilateral basis rather than multi-branch.

Credit exposure is reduced through lower delivery, or settlement, risk (maximum daily delivery risk). A payment netting agreement should be based on novation netting, which means that all transactions with the same value date from which offsetting payments arise are deemed cancelled and are replaced with the residual net obligations. Payment netting has no effect on an institution's capital or balance sheet.

Many of the major participants in the FX market have arranged payment netting procedures as bilateral agreements in order to make the currency payment process more efficient. In any one day, one of the major FX banks may transact exchange contracts many times with the same counterparties. Without a netting agreement, each deal would have to be settled independently, involving much cost and time.

Netting across common currencies and paying and receiving the net differences is very much more efficient and the FX market is attempting to move towards netting agreements as standard.

In addition to the bilateral agreements, banks can sign up to netting organisations (such as ECHO - the Exchange Clearing House). These organisations act to net FX transactions electronically (ECHO uses the SWIFT system) and may seem, at first sight, to be acting in the role of a clearing

house for FX. This is true except for one obvious difference; payment and receipt of currencies, although netted, are still with individual banks and are still bilateral contracts, the banks dealing directly with each other. Thus we have an OTC market with central clearing - the best of both worlds - and this is the direction that is being taken, worldwide, in foreign exchange. At present FX options only form part of such netting through exercise into a normal spot transaction. In fact, owing to the frequent occurrence of FX option exercise strike rates being 'off market', such spot transactions emanating from option exercise are often excluded from netting arrangements.

The advantages of netting extend beyond the obvious reduction in the number of payments because netting also represents a decrease in a counterparty's credit risk; one net payment instead of many means that the delivery risk is brought to a much reduced level.

Option counterparty risk factors

The reader will have noted the FX market methods of recording counterparty credit risk and the forms of netting that take place. Exercise of an option will, of course, produce a FX transaction which will fall under all the procedures of that market. An institution can apply the risk factors for FX to options, except in the following instances:

1 The option may not be exercised, i.e. expire worthless with no consequent delivery of foreign exchange.
2 The control of the exercise (and the creation of a foreign exchange trade) is in the hands of one of the parties to the transaction, the option buyer.

The application of the FX risk factors for options would be conservative because of point 1 above. Furthermore, the market replacement cost to the seller of the option is always zero. The maximum profit is the premium which has already been received, hence market replacement risk lies only with the buyer of the option.

Option counterparty risk is therefore more one-sided than FX. The buyer of the option has all the risks of FX (plus an additional one of premium payment), whereas the seller only has potential delivery risk (and has received a premium payment).

Option market participants have developed many types of measurements for option counterparty credit risk but generally these measures fall into one of two categories: those that use existing FX credit assumptions (i.e.

include options as part of FX exposure) or those that have separate option credit limits for each counterparty.

Using existing foreign exchange credit lines

Many banks and other institutions use existing FX counterparty limits owing to the administrative burden of establishing separate option facilities and, for other reasons, often prefer not to segregate.

1 State option face value as deliverable in all cases

Stating the option face value as deliverable is treating options as though they are FX contracts which is conservative, but not representative of the actual credit risks. Full line and MDDR limits are applied and no allowance is made for the fact that options sold carry no risks other than (potential) delivery risk. They are very simple to implement, but are very inaccurate.

2 State option face value as deliverable with allowances

Stating the option face value as deliverable with allowances is the same as point 1, except option sales are not recorded under the counterparty credit line but only as deliverable (MDDR). Other concessions may be made to increase further the accuracy of the credit reporting, for example, in the case of option straddles where only one option, the call or the put, can possibly be exercised on maturity (although one must be exercised). An allowance is made to count straddles for the value of one leg, i.e. the call or the put instead of both. This example can be extended to other recognised strategies such as the strangle where one, or neither, of the call or put will be exercised on maturity.

This method is considered to be better than that in point 1 but the processing system must be able to recognise bought from sold (very easy as it is the same as foreign exchange) and strategies such as straddles and strangles (which is not so easy unless indicated at input level).

3 State option delta as the deliverable

The delta of an option can be used as an indicator as to the potential exercise on maturity. This is normally only a percentage of the face value but is more accurate than recording the full face value as in points 1 and 2. Options with little chance of exercise will be reflected as such while deep ITM options will show something like face value.

Option purchases are recorded against both credit line and MDDR but sales are only recorded against MDDR, as in point 2, except by delta amount only. No allowance need be made for option strategies such as straddles and strangles as these will automatically be adjusted through the delta calculation.

This is a much more accurate measure of options delivery risk but it reveals a big disadvantage when incorporation into FX systems is attempted; the delta value changes with spot movement and with time decay. Thus a counterparty may be within an assigned credit or delivery limit on one day, and over the limit the next day, owing to delta change without any further transactions.

The examples of current market practice discussed here are but a few and are only concerned with delivery risk. Market replacement cost methods are similar for FX and for options bought, in that a limit is applied based on the acceptable amount of risk for the counterparty concerned. This method also controls any attempt to construct synthetic loans through options that would otherwise not be evident, i.e. using solely delivery risk methods.

Using separate option credit lines

Specific option lines, rather than being incorporated into existing FX facilities, bring some major benefits. The options trading is not tied to the same counterparties as in FX, which is a considerable benefit in the cases of transactions with non-professional parties who normally purchase options as hedging instruments.

Delivery risk

Selling options carries just one risk - potential delivery of the currency - but this can be negated entirely (for client transactions) by applying the cash settlement principle. Instead of exchanging currencies on the value date, a payment is made to the client which represents the intrinsic value of the option on the expiry date, in a similar manner to that described in the old LICOM terms and the current definition in the ICOM Master Agreement of in the money amount.

Another way of evading delivery risk is to pay currency only upon receipt of the countercurrency - a process known as payment versus payment, or PVP. This may involve a lag of one day - paying the sold currency on the day after receiving the bought currency - but interest can be paid on the overdue amount.

If either of these methods is used, option sales require no credit considerations other than receipt of the premium, and this can be avoided by

having funds available prior to the option transaction being made, i.e. on account. However, both cash settlement and PVP can only be used for an institution's own clients as the interbank market does not generally operate on these terms.

In the case of option purchases, things are very different. While delivery risk can be avoided by cash settlement or delayed delivery - the same as for options sold - the option buyer is always at risk to the value of the option in the market-place (market replacement cost risk). Therefore a suitable limit based on current option valuation has to be applied.

Dedicated option credit lines may address delivery risk in any of the ways discussed earlier, but many institutions tend to use the MDDR method, adjusted for strategies, etc. Although the delta method is more accurate, the variable nature of this technique has proved difficult to explain to credit risk managers who distrust any system that does not fix a maximum exposure.

Another interesting point regarding delivery risk arising on exercise of an option is that the option credit risk drops to zero, leaving FX delivery risk in the resulting spot transaction. This is normally absorbed into the FX credit line for the counterparty but, on occasions, the FX line may already be full, so some internal control is required to note the fact that the options line has declined at the same time, leaving the net exposure the same. This effect will not occur if the options credit line includes the delivery process, but the vast majority of institutions use a different system for FX settlement than for options processing.

Market replacement cost risk

Market replacement cost risk methods are similar for FX trades and options purchased (not options sold) in that both take the current market value of the transaction. In FX this is calculated as the current exchange rate minus the original trade rate, the result being either positive or negative. In option purchases the calculation is simply the current premium value of the option in the market-place, which is therefore always negative (it is impossible to buy an option for less than zero!). 'Negative' here means it is a cost (debit) to replace an existing contract with one in the market-place on the basis that counterparty default has resulted in loss of the option rights held through the original purchase.

Option sales, on the other hand, always have a positive market replacement cost owing to the fact that the original premium has already been received and is the maximum profit that can be gained from the transaction. To replace this contract from the market would result in another (extra) premium - a credit. Thus option sales do not have any counterparty credit risk other than potential delivery risk.

Both FX and options-bought contracts share a common factor in market replacement cost risk, i.e. the risk varies according to market movements. This makes credit assessment difficult in that the amount at risk is, technically, infinite. FX rates can rise or fall without restriction whereas other markets are, at least, held on the downside - for example, a stock or share couldn't fall below zero.

This 'limitless' risk factor does cause some problems in controlling counterparty risk should the contract reach unacceptable potential loss levels. One method is to build a buffer on the replacement cost amount - e.g. 120% of market value - so when the credit limit is reached, there is still some leeway before the actual risk limit is reached. All this does is provide a breathing space in which to assess the situation and act accordingly, e.g. the counterparty may warrant a higher limit or, if there are very serious doubts about the counterparty, the option writer may wish to consider a request for adequate assurances under the events of default definition in ICOM terms and conditions.

Another, less drastic, way of reducing accumulated credit risk is to call for a deposit to support the outstanding position; an informal kind of margin. The problem here is knowing one's customer and whether such arrangements are informal or part of the terms of trading. Interbank uses ICOM but each institution has its own terms for customer transactions (which may also be ICOM), so contingency arrangements such as margins should be advised to potential clients before trading commences.

Margins

Margins are normally associated with exchange trading and, of course, they provide the security that enables the exchanges to guarantee the performance of each and every transaction. This methodology can also be applied to OTC contracts to reduce, or negate entirely, the market replacement risk.

Some banks do provide margin accounts for option trading with counterparties whose credit rating is insufficient for normal purposes. Margin accounts with cash settlement facilities (to negate delivery risk) are sometimes used by individuals or small companies. They benefit from avoiding exchange fees and brokers' commissions and are able to deal in any strike, currency pair or amount in the OTC market. The banks benefit from having a captive customer who can only close out contracts with the same bank, although the administrative burden of maintaining margins can be costly.

At the time of writing, margin accounts in OTC are becoming more common as banks respond to a competitive environment and search for additional revenue-producing products.

Master Agreement terms and conditions

International currency options market (ICOM) terms and conditions were introduced in New York, London and Tokyo in 1992/1993 and revised in February 1997. The foreign exchange options master agreement (FEOMA) which allows for netting of foreign exchange spot and forward transactions, as well as FX options, was issued in March 1997.[91] ISDA encompasses both ICOM and FEOMA in its definitions. These terms bring a very important aspect to the OTC market with regard to counterparty credit risk, i.e. the netting of outstanding contracts and subsequent cash settlement in cases of default. Banks and other institutions operating under ICOM, FEOMA or ISDA terms using the Master Agreement facility with other market participants will effectively reduce counterparty credit risk by a large extent.

The principles of ICOM, FEOMA and ISDA represent big steps forward in the reduction of credit risk and will eventually spur further liquidity in the market-place.

Conclusion

Each institution will evolve its own system for the measurement of counterparty credit risk but the techniques outlined in this chapter are fairly common. Risk profiles differ greatly in the market-place, as some institutions are more risk conscious than others and some are more active in the markets.

The development of netting (i.e. in event of default) in the FX markets through agreements has already arrived in options with ICOM, FEOMA and ISDA and this process is likely to continue. It is even conceivable that there may be the formation of clearing houses for OTC trades, but one thing is certain, the reduction of counterparty credit risk will continue whatever methods are available. The reasons for this are twofold: the first is the capital adequacy requirements being placed on banks by the central banks and the

91 ICOM, FEOMA and ISDA are discussed in Chapter 14.

second is the vast amounts of losses accumulated by banks in the late 1980s/early 1990s through loan losses. Reduction of risk and expansion of product volume can be achieved but it will be in the form of derivative instruments, such as options and swaps.

Glossary of terms

There follows a list of terms encountered in this book and in the market-place generally. In many cases the wording has been adopted from the British Bankers' Association booklet, *BBA Treasury Terminology 1997*, and, if so, is marked thus: •.

All or nothing option - an *exotic* option.

• An option that pays out a (generally fixed) return only if a certain event occurs; failure to breach this trigger yields no cash flow. Popular versions include *binary* and *digital* options.

American (style) option

• An option which can be exercised on any business day up to and including the expiry date, and for which funds can be exchanged from the exercise date. A variant is the *Bermudan*, or the *window* option, which can only be exercised on a set number of days before expiry.

At-expiry digital - see *binary option*.

At the money (ATM)

A scenario where the price of the underlying is equal (or very close) to the price at which the option can be exercised (the *strike price*).

• An *at the money forward (ATMF)* is where an option has a strike price which is equal to the forward price of the underlying; usually used to refer to conventional *European (style) options*.

- An *At the money spot (ATMS)* is where an option has a strike price which is equal to the spot price of the underlying.

Average rate option - an *exotic option.*

- There are two principal varieties of an average option: average rate option and average strike option.
- An *average rate option* has a settlement value based on the difference between a predetermined strike price and the average of the spot prices of the underlying in the period leading up to and including the expiry date; also known as an Asian option.
- An *average strike option* has a strike price which is calculated at expiry on the basis of the average of the spot prices of the underlying during the life of the option; the settlement value of the option is based on the difference between the averaged strike price and the spot price prevailing at maturity.

Average strike option - see *average rate* option.

Barrier option - an *exotic option.*

A path dependent (or directional) option which is activated (*knock-in option*) or deactivated (*Knock-out option*) if the underlying breaches a preset trigger (i.e. barrier) price; once activated, or prior to deactivation, the barrier option behaves like a normal *European option.*

A *standard (or regular) barrier option* has a trigger level which is out of the money compared to the strike rate (if the trigger is hit, the underlying European option is either going further out of the money or is losing intrinsic value); a *reverse barrier option* has a trigger level which is in the money compared to the strike (if the trigger is hit, the underlying European option is gaining intrinsic value). It is for this reason that reverse barriers are sometimes referred to as *in the money barriers.*

A *double barrier option* is similar to a barrier, but with two trigger points - one in the money, the other out of the money.

Barrier options are also known as *trigger options*, *cut-off options*, *stoptions* and the two forms of knock-in and knock-out (sometimes called kick-in and kick-out) may also have the trigger direction indicated; hence *down and in option*, *down and out option*, *up and in option* and *up and out option.*

Basket option - an *exotic option.*

- This is an option on a basket of underlying instruments; for example, the right to buy or sell two or more currencies (against a base currency) at a combined preselected strike price.

Beta

A term sometimes applied to represent the risk of hedging one *currency pair* against another currency pair. An example might be a USD/CHF option hedged by the opposite position in USD/EUR. Beta positions are correlation-risk sensitive.

Bear spread - a *combination option.*

- An option strategy seeking to profit from an expected decline in the price of the underlying. The strategy combines the simultaneous purchase and

sale of two *put options* with different strike prices but (generally) with the same maturity date; the purchase of a put seeks to profit from falling prices, while the sale of a put generates income to (partially) offset the cost of the option purchase, thus reducing the overall cost of the strategy.

Bear spreads constructed using put options are also called *put spreads*. The bear spread may also be constructed using two call options, in which case the strategy is called a bear call spread. The bear spread has a limited loss, limited profit payout profile.

Bermudan - also known as a mid-Atlantic option (see *American (style) option*).

Bet option - see *binary option*.

Binary option - an *exotic option*.

An option which pays out a specified cashflow only if the spot price of the underlying breaches a specified level; also known as a *digital option*, *bet option* or an *all or nothing option*.

There are two principal varieties of the binary option: *one-touch binary options* also known as *American binaries*, where payment is made if the trigger level is reached at any time during the life of the option; *at expiry binary options*, also known as *European binaries*, where payment is made only if the trigger level (in these cases, the strike price) is satisfied at the expiry date.

There are two varieties of one-touch binaries: *instant one-touch*, where payment is made at the time of the trigger being breached; *one-touch* binaries, where payment is deferred until the original expiry date.

A *double digital option*, also called a *range binary*, can be either an option that pays out a fixed sum if the spot rate touches one of *two* strike (trigger) rates (a *double one-touch*), or if spot remains within the range of the two strikes (a *double no-touch*).

Binomial model

- An option pricing formula that is used primarily in pricing *American (style) options* and *path-dependent options*.
- It is a mathematical model represented as a tree of possible option prices; the tree is calculated on the assumption that, at each specified time interval, there is a predetermined probability that the rate will move up (or down) by a predetermined amount.
- Options can be priced at any of the intervening time intervals by using the predetermined probabilities and size of rate movements to discount the final payment back through the tree of possible prices; the facility to trace a tree of price makes this model particularly useful in the case of options that can be exercised early.

Black-Scholes model

- An option pricing formula used for pricing *European (style) options*; developed in 1973 by Fischer Black and Myron Scholes.
- It is a mathematical model based on the idea of a riskless hedge; the latter presumes a risk-equivalence between options and their underlying, so that

in a hedging scenario a change in the price of one is perfectly offset by a change in the price of the other.

- The model's principal assumption is that the underlying asset price is a random variable with normal distribution; other assumptions include stable price volatility, risk-free interest rates and no transaction costs.

Bull spread - a *combination option.*

- An option strategy seeking to profit from an expected increase in the price of the underlying.
- The strategy combines the simultaneous purchase and sale of two *call options* with different strike prices but (generally) with the same maturity date; the purchase of a call seeks to profit from rising prices, while the sale of a call generates income to partially offset the cost of the option purchase, thus reducing the cost of this strategy.

Bull spreads constructed using call options are also called *call spreads.* The bull spread may also be constructed using two put options, in which case the strategy is called a bull put spread. The bull spread has a limited loss, limited profit payout profile.

Butterfly spread - a *combination option.*

- An option strategy seeking to profit from price stability in the underlying, with risk limited in case there was a dramatic move in the price of the underlying. An ordinary butterfly is the sale (or purchase) of two calls (or puts) at the same strike and the simultaneous purchase (or sale) of two calls (or puts) at different strikes; the latter have strikes that are above and below the strike of the former, both by an equal distance.

Butterfly spreads may also be constructed using all calls, all puts, or combinations of both. In all cases, profit and loss is limited.

Capital adequacy directive (CAD)

With the plans for a European Monetary Union (EMU), certain regulations have been introduced that apply to all European banks, one of which, the capital adequacy directive (CAD), applies to foreign exchange and FX options.

CAD specifies the financial resource requirements for banks (and other investment businesses) and the forms of capital which are permitted to meet those requirements. In simple terms, it means that banks and others will have to maintain a specified amount of capital to support trading in products such as FX options. The greater the potential losses, the higher the level of capital.

Calendar spread - a *combination option.*

- A strategy seeking to profit from price discrepancies in options and futures of the same series but with different maturities.
- The strategy involves the purchase (sale) of a near-dated contract, and the sale (purchase) of a long-dated contract.
- It is used when a futures contract is undervalued (overvalued) in comparison to a longer-dated contract, or when an options series is expected to undergo changes in its volatility term structure.

Call option

- An option which gives the holder of the contract the right, but not the obligation, to buy the underlying at an agreed price within or at a specified time. The seller, or writer, of the option receives a premium in exchange for the risk of having to sell the underlying if the option is exercised. It is purchased to hedge the risk of a rise in prices, or to speculate.

Cap

A term used in interest rate markets for an option that guarantees a ceiling rate on an underlying position.

Cash settled

An agreement whereby an option is settled on exercise by a cash amount paid by the seller to the buyer, rather than by physical exchange of the currencies. The cash settlement amount is the difference between the strike and the current spot rate (the *intrinsic value*) on exercise paid according to the terms governing the contract.

Charm

A risk factor that measures the rate at which *delta* changes over a given time to maturity. This term is not often used in the market-place.

Chooser option - a *combination option* usually quoted as being an *exotic option*.

An option which requires the holder to choose at a preset time (the chooser date) whether to hold a call or put option for the remaining time to expiry.

A simple straddle is better than a chooser option because the choice of whether to have a call or put remains throughout the term. The more restrictive chooser option is, therefore, cheaper than an equivalent straddle.

Cliquet option - an *exotic option*.

An option which allows the holder to lock in the intrinsic value (if any) at predefined time intervals during the life of the option. At such time, the strike rate is reset to the current spot rate.

- This should not be confused with a *ratchet* or a *ladder option* which has trigger points based on price levels rather than time intervals.

Colour

A risk factor that measures the rate at which *gamma* changes over a given time to maturity. This term is not often used in the market-place.

CME

The Chicago Mercantile Exchange, a division of which, the International Monetary Market (*IMM*), trades options on currency futures.

Collar - a *combination option*.

A term used in interest rate markets to describe a *risk reversal, cylinder or range forward* (see *risk reversal*).

Combination options

- An option strategy comprising two or more options; originally dealt as one, but the components may be exercised or traded separately. Common examples of combination options include *strangles* and *straddles*.

Compound option - an *exotic option*.

- An option on an option. It grants the holder the right to buy/sell an option at a preset price on a predetermined date between the trade date and the expiry date; if the first option is exercised, the underlying option will then behave as a standard option.
- The up-front premium of a compound option is less than that of an ordinary European option, if both options are exercised the cost is greater. A compound option is often used, and cited, as the perfect hedge in a tender to contract situation.

Contingent (premium) option - an *exotic option*.

- An option for which the holder only pays the premium if the option is exercised. The holder has an obligation to exercise if the option is in the money on maturity, regardless of whether there is sufficient intrinsic value to cover the premium.
- It can be considered as a combination of a conventional option and a short *binary (digital) option* to offset the initial premium; if the options are in the money, the binary payout is subtracted from the regular payout. If the options are not in the money at expiry, both premium cost and payout are zero; thus, it is a zero-cost option strategy unless exercised.

Covered call writing

- A covered call is an option strategy which consists of writing (selling) a call option and taking a long position in the underlying.
- *Covered put writing* is an option strategy which consists of writing a put option and taking a short position in the underlying. By taking an appropriate position in the underlying, the option (call or put) is covered if it is exercised.

A covered call (put) is a *synthetic short put (call)* through *put-call parity*, hence covered writing as a strategy is in itself impractical in foreign exchange. It is normally used in cases where the underlying position is held for a separate reason (e.g. currency balances held in current accounts).

Cross rates

A cross rate is generally a currency pair where neither currency is the USD. For example, in the three currencies, GBP, EUR and USD, we can obtain *three* exchange rates - GBP/USD, EUR/USD and EUR/GBP. The EUR/GBP pair is a cross rate whose value can be derived from the other two (USD) pairs.

Currency option

- An option to exchange two currencies at a predetermined rate. It is also known as a *foreign exchange (FX) option*.

Currency pair - any two currencies that are to be exchanged at a specified rate.

Cylinder - see *risk reversal*.

Deferred strike option (delayed start option) - an *exotic option* also called a *forward start* option.

- An option that allows the holder to defer the setting of the strike price until an agreed date in the future (also applies to barriers). The deferred price is set at either a pre-agreed multiple of spot or forward rates, or at a pre-agreed absolute difference, on the agreed start date.
- It is often used when the buyer thinks volatility is low in relation to historic volatility, and the buyer wants to lock in a level of implied volatility rates, but doesn't want the strike fixed yet; it can also be used to extend the maturity of an existing option while taking advantage of beneficial levels of volatility.

Delta

The price sensitivity of an option's premium to a change in the price of the underlying, usually measured in terms of a percentage change.

- An at the money option has a delta close to 50%, it is less for out the money options and more for in-the-money options; the higher the delta, the more sensitive the option is to movements in the underlying.
- Also known as the *hedge ratio*, delta allows the user to calculate the amount of the underlying asset which must be bought or sold to hedge the spot risk on the option position; a *delta hedge* is a trade carried out in the underlying in proportion to the option's delta and is transacted by the option holder to hedge risk exposure to changes in the price of the underlying.

An option risk position that has been delta hedged is said to be *delta neutral*.

- (See entry for *gamma* which is the rate of change in an option's delta.)

Delta hedge - see *delta*.

Delta neutral - see *delta*.

Digital option - an *exotic option*.

Another name for a *binary option*, the digital is the term normally applied in foreign exchange option markets. (See binary option.)

Double digital - see *binary option*.

Double no-touch - see *binary option*.

Double one-touch - see *binary option*.

European (style) option

- An option which can only be exercised on the expiry date. The comparative restrictiveness of the European option compared to an American option makes it less valuable and it thus has a lower premium price.

Exchange-traded contract

- Futures and options contracts listed and traded on a recognised exchange. They tend to be standardised products offering a set number of strike prices, exercise dates and special features; not as flexible as custom-designed OTC products.

Exercise

In order to make use of the right possessed by an option holder to buy (call) or sell (put) a specified amount of currency against another, upon receipt of notification, the option writer is obliged to the holder on the terms already agreed.

- OTC FX options normally expire at 10 am New York time or 3 pm Tokyo time; exotic options may have an exercise window of up to four hours before expiry during which the holder may choose to exercise his options.

Exercise price - see *strike price*.

Exotic options

- Options with a more complicated pay-out structure than a plain vanilla call or put option; the latter pays the difference between the strike price and the spot price of the underlying, while the exotic may have a payout (or delivery) based on a variety of special criteria.
- Special elements or restrictions in exotics include path-dependency, average rates, deferred payouts; see entries for *binary*, *cliquet* or *ladder* options for further details.
- Exotics are also known as *non-standard options*.

Options that are not exotic are said to be *plain vanilla*, Regular, Standard or simply European options.

Expiry (maturity) date

- The last day of trading in the futures market. In the options market, it is the only date on which a European option can be exercised, and the last date on which an American option can be exercised. It is also known as declaration date, end date, expiration date and maturity date in other markets.

FENICS

The market standard software for pricing vanilla options. Pronounced 'Phoenix' or 'Fen-nics', this software is produced by Inventure Ltd in the UK and by Inventure Inc in the USA.

FINEX

The abbreviation for the Financial Instruments Exchange, a division of the New York Cotton Exchange (NYCE). FINEX lists currency futures and options on futures.

Floor

A term used in interest rate markets for an option that guarantees a minimum rate on an underlying position. Also: the area where trading takes place in an exchange (also known as the pit).

Forward rate

A forward FX rate is the rate of exchange for a given date beyond spot (FX), sometimes called the forward outright rate or just outright rate. The FX forward rate can be easily calculated given the fixed term interest rates of each currency and the current spot rate. It is sometimes used in the context of a *forward swap*, which is a rate representing the difference between the spot (FX) and forward (FX) rates.

Forward start - see *deferred strike* option.

Forward swap

A forward swap, FX swap, or just forward is a simultaneous purchase (or sale) of a currency at spot - two days - and a resale (or repurchase) of the same currency, and amount, at a date in the future for an agreed difference between the spot and forward rates.

This difference between the *spot rate* and the *forward rate* applied on such transactions represents the yield or cost differential between the two currency interest rates (fixed eurocurrency rates). Because the currency is bought and sold, there is no significant FX risk involved and the FX swap is nothing more than the interest rates differential expressed in FX terms.

Forward outright rate - see *forward rate*.

Futures

- A contract for delivery or cash settlement at a future date at a predetermined price. They can be used for hedging and speculation; they are used to transfer risk from the risk averse to risk seekers. They are different from forwards in that they are *exchange-traded contracts* and hence have standardised exercise prices and maturities.
- The price of financial futures is linked to underlying yields or dividends; the price divergence between a futures contract and the underlying financial asset would allow scope for risk-free arbitrage.

Options are also traded on some futures.

Gamma

- The rate of change in an option's *delta* (the latter term refers to the option's sensitivity to price changes in the underlying). Gamma is at its highest when an option is at the money, and it declines the further away the option is from its strike price. Gamma is higher for options that are nearer to expiry.

Gamma neutral

An option risk position that is not open to profit or loss through gamma is said to be *gamma neutral*. Gamma hedging (to achieve gamma neutrality) can only be achieved through the purchase or sale of options.

Garch

- Generalised auto regressive conditional heteroscedasticity, a statistical technique for estimating historic volatility based on the idea that volatilities are not random walks but vary around a long-term value.

Health - A *FENICS* term.

It represents the relationship of current *spot* (or forward, for forward barriers) to the barrier price. It is essentially the *wealth* of the trigger portion of the option, taking into account the bias of the trigger. Thus, in FENICS, when a barrier option is untriggered, it is considered to have OTM health, and an option with ITM health is considered triggered.

Health = (barrier/underlying spot or forward) expressed as a percentage.

Hedge ratio - see *delta*.

Historic volatility - see *volatility*.

ICOM

Abbreviation for international currency option market terms and conditions issued by the British Bankers' Association in London in association with The Foreign Exchange Committee of New York, The Canadian Foreign Exchange Committee for Canadian Financial Institutions, and The Tokyo Foreign Exchange Market Committee. ICOM replaced the previous LICOM (London interbank currency options market) terms and conditions in 1992.

IMM

The acronym for the International Monetary Market, a division of the Chicago Mercantile Exchange (CME) on which currency *futures* and currency *options* on futures are traded.

Instant one-touch option - see *binary option*.

In the money (ITM)

- An option whose strike price is more beneficial than the current market price of the underlying instrument. Usually, the further an option is in the money, the greater its *intrinsic value*, and therefore the higher its premium.

Implied volatility - see *volatility*.

Instalment option - an *exotic option*.

- An option whose premium is paid in instalments with the option holder having the right to stop paying at any stage. In effect it is a multiple *compound option*.

Intrinsic value

- The difference between the forward value of the underlying and the exercise price of the option; for an American (style) option, it can be the difference between spot value and exercise price.
- As it is the value of the option if it is exercised immediately, only *in the money* options have a positive intrinsic value; out of the money and at the money options have zero intrinsic value.

(See entry for *time value*.)

ISDA

Abbreviation for International Swaps and Derivatives Association Inc, originally International Swap Dealers' Association. The ISDA Master Agreement is used extensively worldwide.

Kappa - see *vega*.

Knock-in option - an *exotic option*.

- It is a barrier option which comes in two varieties: down and in; up and in.

A *down and in* option is activated when the price of the underlying falls and breaches a preset level; an *up and in* option is activated when the price of the underlying rises and breaches a preset level. (See entry for *barrier option*.)

Knock-out option - an *exotic option*.

- It is a barrier option which comes in two varieties: down and out; up and out.
- A *down and out* option is cancelled when the price of the underlying falls and breaches a preset level; an *up and out* option is cancelled when the price of the underlying rises and breaches a preset level. (See entry for *barrier option*.)

Ladder option - an *exotic option*.

- An option which allows the holder to lock into profits at specified price intervals. If the underlying reaches a preset level (rung on the ladder), then the option's strike price resets to this level; a ladder option may have any number of rungs. A ladder option should not be confused with a *cliquet option* which allows profits to be locked in at specified time, not price, intervals. It is also known as a *ratchet option*.

Lambda

Lambda indicates the leverage of an option, usually measured against a 1% movement in the underlying FX rate. The premium of an option with a lambda of 30 will increase or decrease (depending on whether it is a call or put) in premium value by 30% for a 1% movement in the underlying rate. Lambda increases with the decrease in premium value, hence OTM (low delta) and shorter date options carry the highest lambda.

LICOM - see *ICOM*.

Lookback (optimal rate) option - an *exotic option*.

- An option which grants the holder the right to buy/sell the underlying at expiry at a price equal to the most favourable rate observed during the contract period of the option.
- An *optimal rate lookback option* at the outset fixes the strike to be the highest spot rate (call option) or the lowest spot rate (put option), and is delivered in cash; an *optimal strike lookback option* fixes the most favourable strike rate at expiry against the prevailing spot rate, and is deliverable in cash or physical.
- As it offers a better payout than a plain vanilla option, a lookback option commands a higher premium. (See also entry for *shout option*.)

Margin

- A deposit of funds to cover possible losses on open market positions held - can be either initial margin or variation margin. *Initial margin* - in exchange-traded derivative contracts (e.g. futures and options) this is the collateral paid to the clearing house or the brokerage at the start of the contract. *Variation margin* - paid on open positions that show an unrealised loss when marked to market against closing prices; where the losses incurred breach the minimum level of maintenance margin required for margin trading, a margin call is made. A *margin account* is an account enabling a market participant to trade an instrument without having the full funds available; allows for leveraged trading where a small initial position has the potential to generate disproportionate risks or rewards.

MATIF

The acronym for the Marché à Terme International de France in Paris. The MATIF lists foreign exchange options as one of its products.

Mid-Atlantic option - another name for a *Bermudan* option. See *American (style) option*.

Naked hedging

A form of hedging based on the principle that an option would only be exercised if, on maturity, it were in the money. No hedge is maintained when the option is out of the money (OTM) and 100% is hedged when in the money (ITM), all hedging being done at the strike price. This method is usually employed by writers of options who hope to profit by the premium receipt.

Non-standard option - see *exotic options*.

NYCE

The New York Cotton Exchange, a division of which (*FINEX*) trades currency futures and options on futures.

Omega

- In options trading, the currency risk involved when a buyer or seller accounts for a deal in a different currency than the one in which the trade is transacted.

One-touch option - see *binary option*.

Open interest

- The number of outstanding contracts for a given futures contract which are not offset by an opposing transaction by the same counterparty, or fulfilled by delivery. Open interest is usually measured on a daily basis and is sometimes thought to reflect the degree of liquidity in a particular futures contract.

Option

- An option gives the buyer the right, but not the obligation, to buy (call option) or sell (put option) a specified underlying; it is used to hedge risk exposure or to undertake directional trades.
- There are two main varieties of options: *American*, which can be exercised at any time up to the strike date; *European*, which can only be exercised at the strike date. There are many variations of the plain vanilla model, such as barrier options or binary options (see relevant entries).
- Options are either exchange-traded or over the counter (OTC). Exchange-traded options are usually standardised contracts with standardised features, while OTC options are individually negotiated between the two counterparties and have specially tailored features.
- *Option premium* is the price paid for the right to hold the option, and paid by the purchaser to the writer of the option; the premium for a plain vanilla option is made up of intrinsic value plus time value.
- *Option series* are options contracts on the same underlying with the same expiry date and strike prices; put and call options on the same underlying, with the same expiry date and strike prices would form two different series.

Option replication

A method where the performance of an option is replicated by *delta hedging*.

Out of the money (OTM)

- An option whose strike price is less beneficial, for the buyer, than the current market price of the underlying instrument; thus, options with zero intrinsic value.

Outright rate - see *forward rate*.

Over the counter (OTC)

A financial transaction that takes place outside the confines of a registered exchange.

Path-dependent option - one kind of *exotic option*.

- Any option where the payout at expiry depends not only on the value of spot at expiry, but also on the value of spot during the entire period from the deal date to expiry. All options which can be influenced by the spot level before expiry (e.g. options with early exercise or knock-out features) are path dependent. For options that do not depend solely on the value of spot at expiry, the full-term structures of volatility and interest rates are needed to ensure accurate pricing.

Phi - see *rho*.

PHLX

The abbreviation used for the Philadelphia Stock Exchange usually pronounced as 'Phillex'. The PHLX was the first exchange to list currency options in the USA.

Plain vanilla option - see *vanilla option*.

Position

The common term applied to represent a trader's net risk exposure. A simple purchase of EUR against the sale of USD in foreign exchange would give a long EUR position and (at the same time) a short USD position. The purchase of a USD put option would give a long option position (i.e. bought option position) but a short underlying FX position in USD (because exercise of the option would result in selling USD).

Power option - an *exotic* option.

An option that has the underlying rate raised to a power to determine the payout at expiry. The holder of a power option where the power is two will get the value of the underlying squared minus the power option strike rate. The idea is to maximise the gearing effect on the movement of the underlying market. Power options can be used in foreign exchange but are uncommon.

Premium - see *option*.

Profit sharing (participating) forward - an *option combination*.

An OTC hedging strategy whereby an out of the money call (put) is purchased and given 100% protection at set rate (the strike) against a rise (fall) in the underlying FX rate. At the same time, a sale of an in the money put (call) is made to a proportion of 100% whereby the net premium is reduced to a satisfactory level (usually zero). If the FX rate moves against the underlying position, full protection is given at the strike rate but, if the FX rate moves favourably, then only a proportion (the sold option amount) of 100% is given up.

Put–call parity

- The theoretical relationship between the price of a put and a call, both European style, with identical strike prices and maturities. The theory holds that a portfolio containing asset X, plus a put option on asset X is of equivalent value to a portfolio containing a call option on asset X, plus cash held at a

risk-free rate of return, or vice-versa. Option pricing, according to this theory, could hence be arbitraged until the put-call parity was re-established.

Put option

- An option contract which gives the buyer or option holder the right, but not the obligation, to sell the underlying at an agreed price within a specified time. The seller or option writer has the obligation to buy the underlying if the option holder exercises his right to sell. A put option is purchased to hedge the risks of a fall in prices, or to speculate.

Quanto option - an *exotic option.*

The payout of a quanto depends not only on the underlying price movement but also on the size or amount generated by virtue of that movement. The name is an abbreviation for 'quantity-adjusted option'. Quantos are used extensively in fund management where FX risk is created by investment in foreign equity markets and are equity-based products that eliminate FX risk rather than FX products.

Rainbow option - an *exotic option.*

- An option that is linked to not one underlying, but to several; the price of a rainbow option is linked to the correlation of two or more underlying assets. It is also known as a *multi-factor option.*

Range binary

Another name for a *double digital* (double binary). (See entry for *binary.*)

Range forward - see *risk reversal.*

Ratchet option - another name for a *ladder option.*

Ratio spread - an *option combination.*

- An option strategy used to benefit from a favourable move in rates.
- A *call ratio spread* is a strategy whereby uneven amounts of calls at two different strike prices, but for the same expiry date, are simultaneously bought and sold; a *put ratio spread* is a similar strategy, using puts rather than calls. The purchase of ITM options is financed by the sale of a greater number of OTM options.

Rho

- The sensitivity of the value of an option premium to changes in interest rates. The size of the rho is one of the factors that affect the future value of an option, and its time value; the nearer an option is to maturity, the greater the impact of its rho, but in other circumstances it is relatively unimportant in its effect on option pricing.

In foreign exchange options, rho is sometimes referred to as the sensitivity of the countercurrency interest rate (usually the USD) with *phi* as the sensitivity of the cur-

rency interest rate. Both are reflected in the change of the FX forward rate but rho also affects the discounting of the premium.

Risk reversal

An *option combination*; also called a *cylinder*, *range forward* or *collar*.

This strategy involves the purchase of a call and the sale of a put (or vice versa) with different strikes, whereby the premium received from the written option offsets the cost of the purchased option, producing a zero cost strategy.

A very popular way of trading the *skew* of volatility in the interbank market, the Risk reversal is usually constructed using 25% delta calls and puts. The risk reversal is also a popular OTC hedging strategy and in this connection the other terms - cylinder, range forward and collar - are often used.

Rolling spot

An exchange traded futures contract that mimics activity in spot FX markets where positions must be renewed or rolled over each day.

- Rolling spot futures remove the need to roll positions forward and are settled through a clearing house. Options are also traded on these futures.

Seagull - an *option combination*.

An OTC strategy used for hedging that involves using both call and put options across three different strike rates. It is like a risk reversal with an addition option at a third strike.

Shout option - an *exotic option*.

- An option which allows the holder to lock in a minimum return (during the lifetime of the option) if he/she believes that the market is at its high or low.

The shout option has a strike reset at the level 'shouted' and is thus more restrictive than a *lookback option* where the option can be exercised retroactively at the most beneficial price within a set period.

- The holder of the shout option can benefit from the market closing at a higher level than that 'shouted', but he/she will not benefit if the market rises after profits are locked in but declines below the shout level before the close.

Sigma - see *vega*.

Skew (of volatility)

The effect whereby OTM calls are traded at different levels of volatility than the equivalent delta puts, producing a skew of the *smile* of volatility. The Black-Scholes option-pricing model does not recognise the skew of volatility.

Smile (of volatility)

The effect whereby OTM calls and puts are traded at higher levels of implied volatility than those options that are at the money. The *Black-Scholes option-pricing model* does not recognise the smile of volatility.

Speed

A risk factor that measures the rate at which *gamma* changes with a given change in the underlying FX rate. It is not a term used much by practitioners.

Spot (rate)

In foreign exchange (FX) markets, spot refers to the delivery date (or settlement date) whereby the exchange of currencies takes place and is usually two business days from the transaction, or deal, date. If a spot dealer enters into a FX contract today, and today is Thursday, then the spot date is next Monday (providing there are no bank holidays).

Stealth - a FENICS term that applies to *barrier* options.

Stealth is the relationship of the barrier price to the strike price. It can also be looked at as how far in or out of the money the vanilla part of the option will be when it is triggered. Most standard knock-outs and knock-ins have OTM stealth, meaning that the underlying vanilla option will be OTM when it is triggered. All reverse knock-outs and reverse knock-ins have ITM stealth, but regular knock-outs and knock-ins may have also. Stealth = (barrier/strike).

Straddle - an *option combination.*

- A volatility trade which involves the simultaneous purchase (or sale) of a call and put option, with the same expiry date and (usually, at the money) strike price. A straddle is purchased to profit from an expected upturn in volatility; a seller of a straddle benefits from price stability and the income from the two option premiums purchased.

Straddles are primarily used for trading rather than hedging and are often used in the interbank market to trade the *smile* of volatility.

Strangle - an *option combination.*

- A volatility trade which involves the simultaneous purchase (or sale) of a call and put option, with the same expiry date but different strike prices - both out of the money. The premium for a strangle is less than a straddle as the options are out of the money, and a significant upturn in volatility is needed for profits to be made by the buyer; a seller of a strangle benefits if prices remain within the break-even range, which are the strike prices plus the premium earned.

Strike price (rate)

- In a conventional option, it is the preset price agreed at the opening of a contract as the level at which the underlying asset will be delivered in the event the option is exercised. In exotic options, the price may be reset during the course of the contract or fixed at maturity; for instance, a ladder option or a lookback option. It is also known as the *exercise price (rate)*.

Synthetic call

- A synthetic instrument which is constructed to replicate the behaviour of a call option; usually used as an alternative hedging strategy on an existing position.
- *Synthetic long call* - established by the purchase of a put option and a long underlying position; the long underlying offers unlimited profit potential from rising prices and the purchased put ensures limited loss from falling prices.
- *Synthetic short call* - established by the sale of a put option and a short underlying position.

Synthetic put

- A synthetic instrument which is constructed to replicate the behaviour of a put option; usually used as an alternative hedging strategy on an existing position.
- *Synthetic long put* - established by the purchase of a call option and a short underlying position; the short underlying offers unlimited profit potential from falling prices and the purchased call ensures limited loss from rising prices.

Synthetic short put - established by the sale of a call option and a long underlying. The same effects as a covered call *writing*.

Swift

Society for Worldwide Interbank Financial Telecommunications. The SWIFT currency codes are used extensively in the FX markets. These three-letter codes are standard for all professional transactions.

Theta

- The measure of daily change in the value of an option owing to a predetermined decrease in the time till expiry; in this analysis, all other market rates are held as constant, so the change is the decline in time value.

A long (short) conventional option has negative (positive) theta - as time passes the option declines in value unless market rates move in a favourable direction (more complex options can display positive or negative theta on both long and short option positions).

- Theta is also called time decay.

Time value

- The value of an option premium is the sum of its intrinsic value and its time value; the further an option is from expiry, the greater its time value (and vice versa). Time value is an attempt to evaluate the potential that an option will be exercised, a probability that depends on the volatility of its underlying.

Trigger option - another name for a *barrier option*.

Vanilla, or plain vanilla, option

Any option that is not an *exotic option*. Vanilla options are also called regular, standard, or simply European options.

Vanna - a *FENICS* term.

Vanna was introduced as a risk measure in *FENICS* version 6.1 and has been generally adopted to describe the change in delta owing to a movement in volatility (rather than the FX rate).

Vega

- The measure of change in the value of an option owing to a percentage change in the volatility of the option.

A long (short) conventional option always has positive (negative) vega as it increases in value as volatilities rise (a more complex option could have positive or negative vega on both long and short option positions). Some markets have other names for vega such as *kappa* and *sigma* but vega is, by far, the most used expression.

Volatility

Option volatility comes in two forms: historic and traded (or implied). *Historic volatility* is a calculated rate of change of a series of past spot prices. *Traded*, (or *implied*, the common expression) volatility is the option market expectation of future spot volatility over the term of the option in question. It is traded on a bid/offer basis in the interbank market. *Vega* measures the change in an option's value (premium) owing to a percentage move in volatility.

Wealth - a *FENICS* term.

Wealth is the relationship between strike and spot (forward). Previously called 'moneyness', wealth describes the amount by which the option is in, or out, of the money relative to either spot or the forward, hence spot wealth and forward wealth. For ITM options, the forward wealth is the intrinsic value for European-style options. Wealth = (strike/underlying spot or forward) expressed as a percentage.

Window barrier option - an exotic option.

A regular option that behaves like a barrier option (i.e., it can be knocked out/knocked in according to type) for a predetermined period (the window) during the life of the option. It is cheaper than a regular option but more expensive than the equivalent (normal) barrier option.

This page intentionally left blank

APPENDIX

I

Currency codes

SWIFT (Society for Worldwide Interbank Financial Telecommunication) currency codes are used extensively in the foreign exchange markets. These three-letter codes are standard for all professional transactions.

SWIFT supplies secure messaging and interface software to about 6500 financial institutions in 184 countries. In 1998, SWIFT's global network carried over 900 million messages. The average daily value of payments messages on the SWIFT network is estimated to be above USD 2 trillion. In addition to its 2848 member banks live on the network, SWIFT users include sub-members and participants such as brokers, investment managers, securities deposit and clearing organisations, and stock exchanges.

The following list of currencies and the respective SWIFT codes are arranged alphabetically by the *country* name:

AFA	Afghanistan	Afghani
ALL	Albania	Lek
DZD	Algeria	Algerian dinar
AON	Angola	New kwanza
XCD	Anguilla	East Caribbean dollar
XCD	Antigua & Barbuda	East Caribbean dollar
ARS	Argentina	Argentine peso
AMD	Armenia	Dram
AWG	Aruba	Arubian guilder
AUD	Australia	Australian dollar
ATS	Austria	Schilling (euro)

AZM	Azerbaijan	Manat
BSD	Bahamas	Bahamian dollar
BHD	Bahrain	Dinar
BDT	Bangladesh	Taka
BBD	Barbados	Barbados dollar
BYB	Belarus	Belarussian ruble
BEL	Belgium	Belgian franc (euro)
BZD	Belize	Belize dollar
BMD	Bermuda	Bermudan dollar
BTN	Bhutan	Ngultrum
BOB	Bolivia	Boliviano
BAD	Bosnia-Herzegovina	Dinar
BWP	Botswana	Pula
BRL	Brazil	Real
BND	Brunei	Brunei dollar
BGL	Bulgaria	Lev
BIF	Burundi	Burundi franc
KHR	Cambodia	Riel
CAD	Canada	Canadian dollar
KYD	Cayman Islands	CI dollar
XAF	Central African Republic	CFA franc
CLP	Chile	Peso
CNY	China	Yuan renminbi
COP	Colombia	Peso
CRC	Costa Rica	Colon
HRK	Croatia	Kuna
CUP	Cuba	Peso
CYP	Cyprus	Pound
CZK	Czech Republic	Koruna
DKK	Denmark	Krona
DJF	Djibouti	Djibouti franc
DOP	Dominica	Peso
ECS	Ecuador	Sucre
EGP	Egypt	Egyptian pound
EEK	Estonia	Kroon
ETB	Ethiopia	Birr
EUR	European Union	Euro
FJD	Fiji	Fiji dollar
FIM	Finland	Markka (euro)
FRF	France	Franc (euro)
GMD	Gambia	Dalasi
GEL	Georgia	Lari
DEM	Germany	D-Mark (euro)
GHC	Ghana	Cedi
GIP	Gibraltar	Gibraltar pound
GBP	Great Britain	Pound sterling
GRD	Greece	Drachma
XCD	Grenada	East Caribbean dollar
GTO	Guatemala	Quetzal
GNF	Guinea	Guinea franc

GYD	Guyana	Guyana dollar
HTG	Haiti	Gourde
HNL	Honduras	Lempira
HKD	Hong Kong	HK dollar
HUF	Hungary	Forint
ISK	Iceland	Krona
INR	India	Rupee
IDR	Indonesia	Rupiah
IRR	Iran	Rial
IQD	Iraq	Dinar
IEP	Ireland	Punt (euro)
ILS	Israel	Shekel
ITL	Italy	Lira (euro)
JMD	Jamaica	Jamaica dollar
JPY	Japan	Yen
JOD	Jordan	Jordann dollar
KZT	Kazakhstan	Tenge
KES	Kenya	Shilling
KWD	Kuwait	Dinar
KGS	Kyrgyzstan	Som
LVL	Latvia	Lat
LBP	Lebanon	Pound
LSL	Lesotho	Loti
LRD	Liberia	Liberian dollar
LTL	Lithuania	Litas
LUF	Luxembourg	Luxembourg franc (euro)
MKD	Macedonia	Denar
MGF	Madagascar	Malagasy franc
MWK	Malawi	Kwacha
MYR	Malaysia	Ringgit
MTL	Malta	Maltese lira
MRO	Mauritania	Ouguiya
MUR	Mauritius	Mauritius rupee
MEP	Mexico	Peso
MDL	Moldova	Leu
MNT	Mongolia	Lugrik
MAD	Morocco	Dirham
MZM	Mozambique	Metrical
MMK	Myanmar	Kyat
NAD	Namibia	Namibian dollar
NPR	Nepal	Nepal rupee
NLG	Netherlands	Guilder (euro)
NZD	New Zealand	NZ dollar
NIO	Nicaragua	Cordoba oro
NGN	Nigeria	Naira
NOK	Norway	Krone
OMR	Oman	Rial
PKR	Pakistan	Pakistan rupee
PAB	Panama	Balboa

PYG	Paraguay	Guarani
PEN	Peru	Sol
PHP	Philippines	Peso
PLN	Poland	Zloty
PTE	Portugal	Escudo (euro)
QAR	Qatar	Rial
ROL	Romania	Leu
RUR	Russia	Ruble
RWF	Rwanda	Franc
WST	Samoa	Tala
SAR	Saudi Arabia	Riyal
SCR	Seychelles	Rupee
SLL	Sierra Leone	Leone
SGD	Singapore	Singapore dollar
SKK	Slovakia	Koruna
SIT	Slovenia	Tolar
SOS	Somalia	Shilling
ZAR	South Africa	Rand
ESP	Spain	Peseta (euro)
LKR	Sri Lanka	Rupee
SDD	Sudan	Guilder
SRG	Suriname	Guilder
SZL	Swaziland	Lilangen
SEK	Sweden	Krona
CHF	Switzerland	Swiss franc
SYP	Syria	Pound
TWD	Taiwan	New Taiwan dollar
TJR	Tajikistan	Ruble
TZS	Tanzania	Shilling
THB	Thailand	Baht
TOP	Tonga	Pa'anga
TTD	Trinidad & Tobago	TT dollar
TND	Tunisia	Dinar
TRL	Turkey	Lira
TMM	Turkmenistan	Manat
UGX	Uganda	Shilling
UAK	Ukraine	Karbovanet
AED	United Arab Emirates	UAE dirham
GBP	United Kingdom	Pound sterling
USD	United States	Dollar
UYU	Uruguay	Peso
UZS	Uzbekistan	Sum
VUV	Vanuatu	Vatu
VEB	Venezuela	Bolivar
VND	Vietnam	Dong
YER	Yemen	Rial
YUM	Yugoslavia	New dinar
ZRN	Zaire	New Zaire
ZMK	Zambia	Kwacha
ZWD	Zimbabwe	Dollar

APPENDIX

II

London Code of Conduct

The FSA (Financial Services Authority) London Code of Conduct sets out the general standards and controls required covering foreign exchange (including options), deposits, bullion and other products and gives a statement of best practice in dealing principles and procedures. The Association of Corporate Treasurers (ACT) commends this code to its members which also acts as a guideline to best practice in the markets to which the members should adhere.

The London Code of Conduct is available by download from the FSA website on http://www.fsa.gov.uk.

The FSA may be contacted at the following address:

25 The North Colonnade
Canary Wharf
London E14 5HS
Tel: +44 (0) 171 676 1000
Fax: +44 (0) 171 676 1099

This page intentionally left blank

APPENDIX

III

Exchange contract specifications

Exchange contract specifications are not listed here but contact numbers and website addresses are given for the major currency and option exchanges in order that the reader may obtain up to date information easily.

Exchange contracts are constantly under review with changes taking place frequently. Some contracts, although listed, may not have sufficient liquidity for corporate use and the reader should check the volume figures published by the relevant exchange for a particular contract. Fortunately, both contract specifications and volume numbers are easily available from the respective exchange websites. These are listed below.

Philadelphia Stock Exchange (PHLX)
1900 Market Street
Philadelphia
PA 19103 3584
USA
Tel: 1 800 THE-PHLX
Fax: +1 (215) 496 5460
Website: http://www.phlx.com
E-mail: info@phlx.com

Chicago Mercantile Exchange (CME)
30 South Wacker Drive
Chicago
Illinois 60606

USA
Tel: +1 (312) 930 1000
Website: http://www.cme.com
E-mail: CME Chicago
CME (London office)
Pinnacle House
23-26 St Dunstan's Hill
London EC3R 8HN
UK
Tel: +44 (0) 171 623 2550
Fax: +44 (0) 171 623 2565
E-mail: CME London

The Financial Instrument Division (FINEX) of the New York Cotton Exchange (NYCE)
New York Cotton Exchange
Four World Trade Centre
New York
NY 10048
Tel: +1 (212) 742 5050
Fax: +1 (212) 742 5026
Website: http://www.nyce.com

FINEX (Europe)
Dublin Exchange Facility
International Financial Services Centre
Dublin 1
Ireland
UK
Tel: +353 1 607 4000
Fax: +353 1 607 4064

APPENDIX

IV

International OTC market terms and conditions

This appendix reproduces the 1997 International Currency Options Market (ICOM) Terms - issued February 1997. The British Bankers' Association (BBA), Pinners Hall, 105-108 Old Broad Street, London EC2N 1EX, Tel: 0171 216 8856, Website: http://www.bankfacts.org.uk also publishes the following publications in association with The Foreign Exchange Committee of New York, The Canadian Foreign Exchange Committee for Canadian Financial Institutions, and The Tokyo Foreign Exchange Market Committee:

- 1997 International Foreign Exchange Market Master Agreement Terms (IFEMA) - issued March 1997.
- The 1997 Foreign Exchange Options (FEOMA) Master Agreement - issued March 1997.

All carry copyright protection.

The International Swaps and Derivatives Association, Inc (ISDA), 600 Fifth Avenue, 27th Floor, Rockefeller Center, New York, NY 10020-2302, Website: http://www.isda.org publishes the *1998 International Swap and Derivatives Association (ISDA) Foreign Exchange and Currency Options Definitions*. The publication carries copyright protection (1998) by ISDA, Emerging Markets Traders Association and The Foreign Exchange Committee.

GUIDE TO THE 1997 INTERNATIONAL CURRENCY OPTIONS MARKET (ICOM) MASTER AGREEMENT TERMS

The British Bankers' Association
in association with

The Foreign Exchange Committee of New York

The Canadian Foreign Exchange Committee
for Canadian Financial Institutions

and

The Tokyo Foreign Exchange Market Committee

February 1997

Guide to 1997 International Currency Options Market Master Agreement Terms

I Introduction

Following the publication in August, 1985, of "LICOM Terms", which were intended to reflect and to encourage good market practice and to reduce the need for specific legal documentation between participants in the London interbank over-the-counter currency options market, the market continued to evolve internationally. By 1989, it became apparent that the original terms did not adequately reflect market practice. In particular, the number and diversity of market participants had increased substantially, and new practices had been adopted, such as volatility quoting, which were not envisaged in 1985.

Accordingly, in May, 1989, the BBA re-established, through its Foreign Exchange Committee, a Working Party to liaise with market interests, including the Foreign Exchange and Currency Deposits Brokers' Association, with a view to updating the 1985 terms and to provide guidance as to market practice. The Working Party was comprised of members representing a broad spectrum of international financial institutions. In addition, emphasis was placed on the international acceptance of the revised terms, and a new title was developed: International Currency Options Market Terms and Conditions – "ICOM Terms". The Bank of England was represented as an observer on the Working Party.

During this same period, a similar effort was underway in the United States. In early 1986, The (U.S.) Foreign Exchange Committee issued draft Recommended Terms and Conditions For Dealing in the United States Market – "NYICOM Terms", which were drafted by the Financial Markets Lawyers Group. Both groups are sponsored by but independent of the Federal Reserve Bank of New York (the "FRBNY"), and their members are from institutions which participate in the interdealer foreign exchange market. The NYICOM Terms, which were based upon, and substantially similar to, the original LICOM Terms, were intended to reflect general market practice in the United States. Over a period of time, the NYICOM Terms were retitled "USICOM Terms", for United States Interbank Currency Options Market Terms.

Although the USICOM Terms generally reflected market practices in the U.S., they did not address the increasingly important issue of counterparty credit risk and, in particular, the substantive rights and obligations of the parties upon (i) the nonperformance of an option by one of the parties, (ii) the insolvency of one of the parties or (iii) the occurrence of force majeure or some other event which makes it illegal or impossible for one of the parties to perform. The USICOM Terms also did not provide a method for closing out and liquidating options upon the occurrence of one of these events. In 1990, the USICOM Terms were revised into a draft form of master agreement, which attempted to reflect market practice with respect to the formation, exercise and settlement of options (including such matters as net cash settlement and automatic exercise), as well as set forth the substantive legal rights and obligations of the parties.

In the summer of 1990, representatives of the Working Party and The Financial Markets Lawyers Group met to resolve the differences between the ICOM Terms and the USICOM Terms and to develop a single document for use in the international over-the-counter foreign currency options market. The result was the International Currency Options Market Master Agreement ("Original ICOM") which was published in the U.S. in April 1992 and in England in August 1992. Following publication of Original ICOM, the same representatives met to develop a master agreement for spot and forward foreign exchange. That agreement, the International Foreign Exchange Master Agreement ("IFEMA") was published in 1993.

Because the foreign exchange markets are continually evolving, and because IFEMA reflected new thinking about certain issues, IFEMA differed in certain respects from Original ICOM. For that reason, the two groups decided to revisit and update ICOM. The attached form (the "Master Agreement" or "ICOM") should be considered as reflective of normal market practice for international interdealer transactions and as appropriate for adoption by market participants as the standard agreement for dealing in this market.

At the same time as they worked on the updated ICOM, the two groups decided to prepare a single form of agreement on which parties may document foreign exchange spot and forward transactions as well as foreign exchange options. That agreement, the Foreign Exchange and Options Master Agreement

("FEOMA") is being published at the same time as ICOM. Users of FEOMA may benefit not only from the ease of documenting multiple related transactions under a single agreement but also from an ability under the laws of many countries (including the UK Capital Adequacy Directive) to net exposures under their cash, forward and options transactions.

The Working Party and the Financial Markets Lawyers Group have confined themselves to practices in the interbank and professional markets, and have not been directly concerned with the terms and conditions upon which individual institutions may choose to deal with their clients (although the Master Agreement could be used in such circumstances). Banks and other professional market participants are, of course, free to deal with each other on the basis of other terms or agreements if they wish, but should consider themselves under an obligation to make clear to each other in what way their terms or agreements differ from the Master Agreement.

It will be standard practice for market participants in the United States market to execute Original ICOM or ICOM in the form of a Master Agreement. In the London market, the Original ICOM Terms or new ICOM Terms are presumed to apply if one of the parties is acting through an office in the United Kingdom. Nevertheless, parties acting through such an office may wish to consider dealing under a Master Agreement, for the benefits derived from a master agreement under the terms of the UK Capital Adequacy Directive.

The following sections of this Guide to the Master Agreement are intended (i) to provide further clarification of normal market practice and (ii) to explain various provisions of the Master Agreement with respect to foreign exchange options covered thereby ("Options") and the significance of their inclusion in the Master Agreement. Therefore, this Guide should be read carefully. Although the Master Agreement does, and is intended to, stand on its own as a legal document, the Guide provides important commentary on current market practice and the Master Agreement.

II. Market Practice

A. *Price Quotation*

There are two generally accepted methods of price quotation – Premium and Volatility. In each case, the counterparties shall agree upon:

Option Style (American or European),
Call Currency and Amount,
Put Currency and Amount,
Expiration Date,
Expiration Time,
Premium Payment Date,
Settlement Date, and
Strike Price.

Counterparties should also agree upon whether they are entering into a contemporaneous foreign exchange transaction (commonly known as a Delta hedge).

Price quotation should be in the form of either:

(a) a *Premium*, where the counterparties agree upon the above terms and on how the premium price should be expressed, e.g. as a percentage of either currency or as one currency in terms of the other (it is also necessary to agree upon a spot rate in the case of a Premium quotation where a Delta hedge forms part of the trade); or

(b) *Volatility*, where the counterparties agree upon the above terms and that the Volatility be expressed as a percentage per annum. It is the factor which, when combined with the Spot Rate, interest factors of the Currency Pair concerned, the days to expiry of the Option and the Strike Price, is used to compute the Premium.

An Option is not a legally binding contract until, among other things, the Premium has been agreed.[1] Therefore, to ensure the ongoing viability of the Volatility method of dealing, it is incumbent on the counterparties to agree on the Premium as soon as possible, and it is imperative that the calculation of the Premium accurately reflects the agreed Volatility and market conditions at the time Volatility was agreed. In the event of a dispute that cannot be resolved between the counterparties through good faith negotiation (or, in the first instance, by reference to recordings of conversations between the parties during which pricing was discussed), prompt reference to mutually acceptable third-party arbitration is suggested. Market participants should note that, as Premium calculation differences are more likely to occur in transactions involving American Style Options, due care should be exercised in entering into such Options.

In addition, when trading Volatility, it is necessary that a spot rate be agreed upon by the counterparties immediately upon entering into the Option. This forms the basis of the underlying foreign exchange transaction (Delta hedge), if any.

B. *Quotation of Expiration Dates*

Generally, there are two methods for quotation of Expiration Dates – quotation of straight Expiration Dates and quotation of Expiration Dates by calendar month.

Straight Expiration Dates

An Option quoted for straight periods (such as 1 month, 2 months, etc.) has as its final Expiration Date the date preceding the equivalent forward date (as dealt in the interdealer foreign exchange market) that will result in settlement on the forward date, if it is exercised on the Expiration Date. If there is more than one solution, the furthest date from the Trade Date will be the Expiration Date.

Example:

Today's date:	March 4
Spot date:	March 6
1 month FX date:	April 6

The Expiration Date for a one-month Option quoted on March 4 will be that date which will result in a Settlement Date of April 6, i.e., April 4, (assuming no weekends or holidays between). To avoid misunderstanding, in the case of periods under one month, it is recommended that the parties refer to an actual date.

Expiration Dates by Calendar Month

Currently, it is market practice to quote for expiration in a particular month without reference to the actual date. In these instances, it is generally understood that the Expiration Date of the Option is the Monday before the third Wednesday of that particular month.

Expiration on Non-Business Days

Although the Master Agreement does not provide that the Expiration Date must be a Business Day (i.e., a Local Banking Day for the office of the Seller that has written the Option), this will customarily be the case. However, some dealers regularly sell Options with Expiration Dates that are not Local Banking Days for their applicable Designated Office. (Similarly, some dealers will accept Notice of Exercise of European Style Options on a non-Business Day.) If the Expiration Date is not a Local Banking Day for the Seller's Designated Office (or if the Seller is willing to accept Notice of Exercise of a European Style Option on a non-Business Day), it is incumbent upon the Seller to make other arrangements (such as designating a different office or an agent for receipt)

[1] The Master Agreement contemplates, however, that an Option is a legally binding contract before the Premium is *paid*. See Section III(D), below.

to enable the Buyer to exercise its Option. In these circumstances, the Seller should notify the Buyer of such arrangements as soon as possible and reconfirm them to the Buyer prior to the Expiration Date.

C. *Confirmations*

The significant terms of an Option should always be established by the parties at the time the Option is entered into. The agreement of the parties on those terms will be set forth in the Confirmation. However, there may be matters relating to an Option that are not required to be set forth in the Confirmation. Market participants are encouraged to include information as to such matters in the "Other terms and conditions" section of the Confirmation. The definition of "Confirmation" provides that a Confirmation may contain other matters that the parties may specify in a Confirmation. That may be particularly necessary for exotic types of Option, such as Barrier Options.

As in the spot and forward currency markets, the prompt exchange of Confirmations (preferably electronically) and their immediate and thorough checking upon receipt (and querying where necessary) is vital to the orderly functioning of the market place, as well as providing a principal defence against many types of fraud. The Option markets are more complex than the cash markets because of the greater number of parameters that need to be specified for each transaction and the different types of Options that may be transacted. This additional complexity reinforces the requirement for Confirmations to be issued promptly. Since, however, Confirmations with respect to Options often contain terms other than the economic terms of the Option, instead of the parties exchanging confirmations, it is common for one party to send a Confirmation for the counter signature of the other party. It is suggested that brokers also send to the counterparties Confirmations of any Options which they arrange. If there has been a misunderstanding between the parties as to the Option terms, this will usually be discovered upon the review of the Confirmation or Confirmations. The non-receipt of an expected Confirmation or any inconsistencies or inaccuracies should be queried or objected to within the time period recognized by local market practice.

A recommended form of Confirmation is included as an example appended to this Guide. Market participants (including brokers) are encouraged to follow the format and terminology suggested in order to reduce the risk of misunderstandings.

Market participants frequently enter into a contemporaneous Delta hedge at the time they enter into an Option (either with the Option counterparty or a third party). It is market practice (and market participants are encouraged) to separately confirm such transactions. In addition, it is suggested that brokers send confirmations of any Delta hedges which they arrange to the parties involved.

Finally, market participants should indicate at the beginning of negotiations, and prior to entering into an Option, in which way their dealings and the formation, exercise or settlement of the relevant Option will differ from established market practice. Similarly, brokers should be mindful of, and adhere to, market practice with respect to the formation of Options and their dealings with Option counterparties (including the issuance of Confirmations in the recommended form).

III. Master Agreement Provisions

A. *Definitions*

For the most part, the definitions used in the Master Agreement are those commonly used by currency options market participants. However, because of the nature of the document (i.e. the form of a master agreement) and because an attempt has been made to define some common terms and phrases which have not heretofore been defined, some of these definitions deserve comment.

1. "Base Currency" is defined as the currency specified by a party on the Schedule to the Master Agreement. Upon an Event of Default, or some other event, which results in the liquidation of outstanding Options, the Base Currency of the Non-Defaulting Party is the currency in which the payment will be calculated and, probably, paid. (See Section III.H.5 and III.H.8 hereof.) It is expected that each party will have a single currency in which it prefers to receive settlement: for example, for U.S. market participants, this will likely be U.S. dollars. UK market participants entering into Master Agreements should specify Pounds Sterling as their Base Currency as a UK liquidation of a company is conducted in Pounds Sterling (i.e., all claims must be made, and all debts and credits are determined, in Pounds Sterling). The UK Terms provide that, if there is no writing between the parties, the Base Currency will automatically be Pounds Sterling.

2. "Business Day" has alternate definitions depending upon the context in which it is used. The Working Party/Financial Markets Lawyers Group found that a single definition would have affected, rather than reflected, market practice.

3. The Buyer of an Option (sometimes referred to as the "purchaser" or "holder") is defined as the owner of the Option. The Buyer may be either the original buyer, an assignee thereof or a subsequent assignee. In any event, for Options between counterparties to be subject to the Master Agreement, the parties must have executed the Master Agreement. If an Option is assigned by a Buyer to a party who has not entered into the Master Agreement with the Seller, the assignee will not have the rights and obligations with respect to automatic exercise, net cash settlement, set-off and termination, and liquidation and close-out set out in the Master Agreement. (Section 11.2 of the Master Agreement provides that neither party may assign nor delegate its rights or obligations, respectively, to a third party without the prior written consent of the non-assigning party.)

4. Counterparties are expected to specify their Designated Offices in Part II of the Schedule attached to the Master Agreement. These are the respective offices of the parties that will deal Options and whose transactions will be subject to the provisions of the Master Agreement.

5. The Effective Date of the Master Agreement is the date the Master Agreement is dated. The Working Party/Financial Markets Lawyers Group recommend that the parties date the Master Agreement the date the Agreement is signed. This date may be important in the event one of the parties becomes insolvent, as some jurisdictions will not give effect to an agreement entered into within a "suspect period" prior to the date of any insolvency proceeding. If the parties wish the Master Agreement to cover transactions entered into before the Effective Date of the Agreement, they should do so in Part I of the Schedule pursuant to Section 2.1 (Scope of the Agreement).

6. The definition of "European Style Option" provides that it is an Option which may be exercised only on its Expiration Date. After considerable discussion among the Working Party/Financial Markets Lawyers Group it was agreed that few European Style Options are exercised prior to this time and that operational problems could result from the earlier exercise of European Options (although this problem was not considered significant). However, the definition does provide that the parties may agree on the acceptability of earlier delivery of Notice of Exercise of these Options. One transaction in which earlier delivery may be contemplated is a Barrier Option.

7. The Events of Default are generally credit-related events, including insolvency, non-payment and the disaffirmation or repudiation of an Option.

   Involuntary bankruptcy proceedings are addressed in clauses (iii) and (iv). Clause (iii) covers such proceedings brought by a governmental authority or self regulatory organization in the country of a party's organization or principal office; in this case, there is no grace period. Clause (iv) covers such proceedings brought by any other party (including a governmental authority or self regulatory organization in a country other than that of a party's organization or principal office); in such a case, there is a grace period in which the defaulting party may attempt to have the proceeding dismissed. A breach of either clause (in the case of clause (iv), when matured) will result in automatic termination if the parties have

specified "Automatic Termination" in Part IX of the Schedule. The Working Party/ Financial Markets Lawyers Group believed that this extreme remedy was appropriate only for proceedings brought by a party's principal regulator.

If the parties are using the ICOM Master Agreement, they may elect in Part XI of the Schedule to have Section 11.14 apply. If Section 11.14 applies, a party may request adequate assurances from its counterparty as to the counterparty's ability to perform an Option. If no such assurances are forthcoming, or the relevant assurances are not, in the good faith opinion of the party requesting the assurances, adequate, then two Business Days after the request for adequate assurances has been given that party may close out and liquidate all outstanding Options. Such a provision protects a party when it has genuine and valid concerns with respect to the ability of its counterparty to perform, even though no other Event of Default has occurred. The concern may be triggered by, for instance, unconfirmed information about the counterparty circulating in the market, the action of a rating agency or the acknowledged credit problems (such as the filing of a petition for bankruptcy or the occurrence of some other insolvency proceeding) of a parent, affiliate or subsidiary of the counterparty.

This provision requires that the request for adequate assurances must be *reasonable* given all the facts and circumstances. If, for example, shortly before the Expiration Date of an Option, the Seller of an Option had defaulted on an obligation to the Buyer which arose out of a transaction not covered by the provisions of the Master Agreement (for example, a securities transaction), it might be reasonable for the Buyer to request adequate assurances of the Seller's ability to perform the Option should the Buyer exercise the Option. On the other hand, it would probably be unreasonable of the Seller to request adequate assurances of a Buyer's ability to perform an unexercised Option which is deep out-of-the-money and has an Expiration Date two months in the future. Similarly, what constitutes adequate assurances in any given situation will depend upon a number of factors, including the reason for the requesting party's concern and request, and whether the party from whom adequate assurances are requested is a Buyer or Seller (or both). For example, if the party which is requested to provide adequate assurances is a Seller of in-the-money Options who has already defaulted on other obligations, adequate assurances may be the delivery of a guarantee or letter of credit to support such party's obligations or the deposit into an escrow account of the currency (or currencies) required to be delivered by the Seller upon exercise of the Option(s). If, on the other hand, a party's concern is triggered by unconfirmed rumours about the financial position of its counterparty, it may be sufficient for the counterparty to provide information to the requesting party proving those rumours to be false. In all cases, the determination of both the reasonableness of the request and the adequacy of the assurances should be fact intensive.

In addition, market participants may want to limit the circumstances that may give rise to a reasonable request for adequate assurances. Some market participants may want to use a side letter for this purpose. Such a side letter is neither required nor encouraged, and the provision described in Section 11.14 should be considered the standard language.

The failure to provide adequate assurances becomes an Event of Default only after two Business Days following the written request therefor. (Pursuant to the provisions of Section 8.5 of the Master Agreement, the party requesting such adequate assurances is entitled to suspend performance of its obligations with respect to any Option during the pendency of such request.)

Clause (viii) of the definition of "Event of Default" provides that it is an Event of Default with respect to a party if the representations and warranties made by such party in Section 7 shall have been false or misleading at the time they were made, provided that the counterparty has given one Business Day's notice of such fact. The representations and warranties made by a party pursuant to Section 7 are considered crucial to the validity and enforceability of an Option and a party's obligations thereunder. Therefore, if the representations and warranties are incorrect, it is deemed a material breach of the Master Agreement thereby allowing the counterparty to effect the close-out and liquidation of all Options pursuant to Section 8.

8. "Expiration Date" (sometimes referred to as the "maturity date" or "expiry date") is defined as the date agreed to as such by the parties. The two methods commonly used for determining the Expiration Date are explained in Section II.B above. Section II.B also contains a discussion of non Business Day Expiration Dates.

9. "Expiration Time" (sometimes referred to as the "cut-off time") is defined as the time agreed to as such by the parties. It is expected that, in keeping with current market practice, the Expiration Time specified will generally be either 10:00 a.m. (New York time) or, for transactions entered into in the Pacific rim, 3:00 p.m. (Tokyo time).

10. The definition of FX Transaction which appears in FEOMA includes not only transactions where the parties exchange the underlying currencies, but, if the parties so choose in Part VI of the Schedule to FEOMA, cash settled transactions. These are usually forward transactions involving a currency where there is no local forward currency market. Where the parties decide to make cash settled forward transactions subject to FEOMA, they must also determine how the close out provisions should apply to such transactions, since the determination of a Close Out Amount under Section 8.1(b)(i)(w) depends on knowing the amount of the forward Currency Obligation, and cash settled forward transactions often provide that the amount of the forward Currency Obligation is not determined until two business days prior to the Value Date (using spot rates in effect at that time). Since cash settled forward transactions often involve currencies for which there is no forward market, use of publicly available forward rates often will not be a viable alternative. Part VI of the Schedule allows the parties to choose their own method of valuing such FX Transactions. Parties might choose to use replacement cost, the loss incurred by the Non Defaulting Party as a result of the default (including loss of bargain, cost of funding and loss incurred as a result of terminating or re establishing a hedge), or a forward yield curve constructed by the Non Defaulting Party in good faith using such factors as it may deem reasonable, such as interbank cash deposit rates, interest rate futures prices and interest rate swap rates. A subcommittee of the BBA Working Party/Financial Markets Lawyers Group is working on recommended provisions.

11. "LIBOR" is used throughout the Master Agreement to determine the rate of interest that is due on late payments, or the rate at which payments not yet due are discounted in the event of that Options are terminated and closed out. In Original ICOM, certain of these payments were based on the funding rate of the Non Defaulting Party. The Working Party and the Financial Markets Lawyers Group determined to recommend the use of a market based rate, rather than a cost of funds rate, since market based rates are easier to prove, and LIBOR is a widely recognized rate. Where a LIBOR rate does not exist, the agreement looks to the average rate at which deposits in the applicable Currency are offered in the "relevant foreign exchange market". This will normally be the country of issuance of the relevant currency, other than in the case of the Ecu.

12. Notice of Exercise of an Option may be given by either telex, telephonic or other electronic means. However, in keeping with market practice, facsimile transmission is specifically excluded as an acceptable method of delivering a Notice of Exercise because of difficulties in ascertaining receipt. In order to avoid confusion, a Notice of Exercise is defined as being irrevocable. Section 5.1 contains the provisions regarding effectiveness of notices of exercise. Clause (i) of that section requires provides that a Notice of Exercise is effective only on a Business Day. Clause (ii) of that section recognizes that a Notice of Exercise is effective only on its Expiration Date, which is the date agreed upon in a Confirmation. Some Sellers will write European Style Options that expire on a non-Business Day. Since they know the date when the Option will be exercised, if at all, they can prepare for this eventually. In this regard, see the discussion under "Expiration on Non-Business Days" in Section II.B above. An American Style Option, on the other hand, is not limited to exercise on a specified day and the Working Party/Financial Markets Lawyers Group does not believe that market participants normally accept exercise of such Options on non Business Days.

13. "Premium Payment Date" is defined as the date agreed to as such by the parties. Generally, the Premium Payment Date will be the Spot Date for the Currency Pair (i.e. the currencies which will be exchanged upon the exercise of an Option). However, for some Options, the Premium will be payable in a currency other that the Put Currency or the Call Currency. In addition, certain Options (such as those commonly referred to as "Boston Options") call for payment of the Premium at a later date (in the case of Boston Options, on the Exercise Date of the Option). In these situations, it is imperative that market participants specifically agree on the Premium Payment Date. Market practice is that the Premium Payment Date is always specified in the Confirmation.

14. The term "Seller" has been used to describe the party that grants an Option. This is the term commonly used for such purpose, although the Seller is sometimes referred to as the "grantor" or the "writer".

15. Generally, the Spot Date will be the second Business Day after a transaction is entered into. However, this general rule is affected by domestic holidays and, at times, the respective principal financial centres of the currencies involved may be dealing for different Spot Dates. In addition, spot transactions in certain currencies, for example Canadian dollars and Mexican pesos, generally settle on the business day succeeding the date of the transaction. Therefore, the term "Spot Date" has been defined by reference to general usage by foreign exchange market participants.

16. "Spot Price" is used in two Sections of the Master Agreement: (i) Section 5, where it is used for purposes of determining the In-the-money Amount, or intrinsic value, of an Option for purposes of net cash settlement (Section 5.5) and automatic exercise (Section 5.3), and (ii) Section 8, where it is used for the purpose of converting the settlement amount calculated upon the liquidation of an Option into the Non-Defaulting Party's Base Currency. In Section 5, the determination of Spot Price is made by the Seller, and in Section 8 it is made by the Non-Defaulting Party. In either case, the definition requires that such determination be made in good faith.

17. The term "Currency" is defined in ICOM to include not only the lawful currency of any country, but also any composite currency, such as the European Currency Unit or ECU. The Working Party/Foreign Exchange Committee recognize that under the Treaty on European Union and the second stage of European monetary union, many European currencies and the Ecu would be replaced by a new currency, sometimes referred to as the "Euro". Plans for introducing the Euro are described in the *Green Paper on the Practical Arrangements for the Introduction of the Single Currency*, which was published by the European Commission on May 31, 1995. Under current proposals, there will be a period when existing national currencies and the new single currency will operate in tandem. Thereafter, national currencies in countries that have adopted the new currency will be replaced by the Euro. These proposals raise numerous issues of public international law which are beyond the scope of ICOM or this Guide. See generally, UK Financial Law Panel, *Response to the European Commission's Green Paper dated 31 May 1995 on the Practical Arrangements for the Introduction of the Single Currency*, October 1995. The parties to an Option under ICOM should be aware of developments which may affect Options settling after January 1, 1999 and should arrange their affairs accordingly.

B. *General*

1. ICOM governs all Options between two Designated Offices of the parties entered into on or after the Effective Date. Before using ICOM, the parties should agree in writing which Options then outstanding between any two Designated Offices are to be subject to the provisions of ICOM. In the case of the ICOM Master Agreement, the parties will complete Part I of the Schedule; in the case of the ICOM Terms, the parties will agree in a separate writing.

2. Section 2.2 states the general intention of the parties that the Master Agreement, the terms agreed between the parties with respect to each Option, and all Confirmations be considered a single agreement. It further states that the parties enter into Options under the

Master Agreement in reliance upon these facts. The intent of these provisions is to provide a legal basis in some jurisdictions for the close-out, liquidation and netting of all Options (as provided by Section 8) upon the occurrence of an Event of Default with respect to one of the parties. These provisions are considered crucial in those jurisdictions to avoid the possibility that a trustee, receiver or conservator of an insolvent party would be upheld by a court in affirming and enforcing some Options (e.g. those which it holds as Buyer which are In-the-money) and rejecting and repudiating others (e.g those as to which it is Seller), the practice commonly known as "cherry picking".

3. An Option becomes a legally binding contract when the essential terms of the Option (Buyer and Seller, Premium, style, type, Strike Price, Put Currency and amount, Call Currency, Expiration Date, Expiration Time and Premium Payment Date) are agreed by the parties. The Option will usually be concluded orally by the traders, in which case the Confirmation will be evidence of the contract.

4. Section 11.15 provides that Confirmations shall be deemed correct absent manifest error three Business Days after receipt by a party. Such manifest error may be evidenced by a tape recording of the conversation of the traders who entered into a disputed Option or their back office personnel. Section 11.3 specifically provides for the tape recording of conversations between the parties and for the use of any such recordings as evidence in any court or in any proceeding. The User's Guide previously stated in Section III(B)(3) that manifest error might be evidenced by the tape recording of the conversation of the traders *who entered into a disputed Option*. This statement was somewhat at odds with Section III(K)(2), which stated that all tape recordings between the parties "are usually the best evidence of the essential terms of an Option". Upon further reflection, the Working Party/Financial Markets Lawyers Group believe that all tape recordings are some evidence of the agreement between the parties, and that no single piece of evidence should be deemed the "best evidence". The trier of fact is in the best position to give all evidence its proper weight.

C. *Representations and Warranties: Contractual Status*

1. The representations and warranties contained in Section 7 are made by each of the counterparties and are intended to satisfy each of the parties that (i) the Master Agreement and each of the Options entered into pursuant thereto are valid and enforceable obligations of its counterparty, (ii) no event which calls into question the credit of its counterparty (i.e. an Event of Default) has occurred, and (iii) the counterparty with which it is dealing is the party that is obligated to perform the Option and the terms of the Master Agreement.

2. Part XV of the Schedule contains four other representations that the parties may wish to add to their Master Agreement where one of the parties is subject to U.S. law or the law of any U.S. state.

   (a) The FDICIA representation is designed to ensure that the Non Defaulting Party may take advantage of the provision of the (U.S.) Federal Deposit Insurance Corporation Improvement Act ("FDICIA"), which ensures the validity of close out netting agreements with a "financial institution" as defined in FDICIA or in regulations adopted by the Board of Governors of the Federal Reserve System.

   (b) The ERISA representation is designed to ensure that Options do not violate the provisions of the (U.S.) Employee Retirement Income Security Act ("ERISA"), by ensuring that the counterparty is not, and is not acting for, an employee benefit plan as defined in ERISA.

   (c) The third and fourth additional representations are designed to ensure that Transactions do not violate the (U.S.) Commodity Exchange Act (the "CEA"), which is administered by the Commodity Futures Trading Commission (the "CFTC"), and governs the trading of futures contracts and options on futures contracts on U.S. commodity exchanges. The CEA also applies to the off-exchange trading of certain products and instruments. Section 2(a)(1)(A) of the Act, the so-called "Treasury Amendment", was adopted in 1974 and provides an exclusion

> from the Act for certain products as follows: "Nothing in this Act shall be deemed to govern or in any way be applicable to transactions in foreign currency, . . . unless such transactions involve the sale thereof for future delivery conducted on a board of trade".

In 1986, the U.S. Court of Appeals for the Second Circuit held that an option on a foreign currency did not fall within this exclusion because it was not a transaction "in" a foreign currency until it was exercised. *Commodity Futures Trading Commission v. The American Board of Trade. Inc. et al.*, 803 F. 2d 1242 (2d Cir. 1986). The Second Circuit followed this ruling in *Dunn v. Commodity Futures Trading Commission*, 58 F. 3d 50 (2d Cir. 1995), despite a contrary ruling by the U.S. Court of Appeals for the Fourth Circuit in *Salomon Forex, Inc. v. Tauber*, 8 F.3d 966 (4th Cir. 1993) which held that the CEA did not apply to off exchange foreign currency options with institutional customers. Unless the U.S. Supreme Court rules on this subject, there will continue to be uncertainty over whether currency options are subject to the provisions of the CEA.

If currency options are subject to that Act, then they may be offered in the U.S. only pursuant to a regulatory exemption from the general ban on the trading of such options contained in Section 4c(b) of the Act. The exemption most commonly relied upon for currency options is the so-called "Trade Option Exemption" contained in CFTC regulation Section 32.4. The Trade Option Exemption provides an exemption from the general ban for commodity options offered to a "producer, processor, or commercial user of, or a merchant handling, the commodity which is the subject of the commodity option transaction, or the products or byproducts thereof" where such party is offered or enters into the option transaction solely for purposes related to its business as such. As the Master Agreement has been drafted for use by the professional market, a representation addressing the status of the parties for purposes of assuring compliance with the Trade Option Exemption was believed to be unnecessary in the main body of the Agreement. However, in those cases in which the Master Agreement is made subject to the laws of the State of New York (or any other state in the United States) and either of the parties is not a professional market participant, the parties should consider the propriety of including in Part XV of the Schedule a representation as to the commercial status of the parties.

Another exemption which may be relied upon is the so called Eligible Swap Participant Exemption contained in CFTC regulation Section 35. The Eligible Swap Participant Exemption provides an exemption from the off exchange trading ban of the CEA for "swap agreements", including currency option agreements, entered into by "eligible swap participants".

3. Section 7.2 allows to the parties to add, in Part XVI of the Schedule, covenants that will apply to one or both parties. Other master agreement forms contain tax representations and covenants. The drafters of the ICOM Agreement determined that such representations and covenants are not standard in agreements covering FX Options. In many countries, the option premium and the exchange of currencies in connection with an FX Transaction are not the type of payments that are subject to withholding tax. Parties should, however, consult with their own advisers to determine whether tax or other covenants are appropriate.

D. *The Premium*

Section 3.2 provides for alternative courses of action in the event that a Premium is not received on the Premium Payment Date. As Premiums are sometimes paid late (due primarily to operational problems or mistakes), under appropriate circumstances a Seller should generally be willing to accept a late payment, and it is common practice in the market for a Seller to do so. However, where the failure to pay the Premium has not been remedied after a short period of time or is credit related, the Seller may choose either to void the Option or to take the more drastic step of declaring an Event of Default. Regardless of the course of action chosen by the Seller, the Seller is entitled to recover its out-of-pocket costs and actual damages incurred, specifically including interest on the amount of any Premium (which would be calculated in the same manner as any other late payment)

and any costs or expenses in covering its obligations (including a Delta hedge). Section 3.2 provides for such recovery in the case of either a late payment or the decision to treat the related Option as void. Where the Seller chooses to declare an Event of Default, such amounts are recoverable under the provisions of Section 8.1(b)(i).

The fact that clause (ii) of Section 3.2 allows the Seller to declare an Option void for failure of the Buyer to pay the Premium does not indicate that an Option only comes into being when the Premium has been paid (*e.g.* that it is otherwise unenforceable for failure of consideration). The consideration for each Option is the mutual promises of the counterparties and the fact that the Seller relies on the existence of a contract in making its hedging determinations. Such mutual promises and reliance also justify a contractual agreement that the Premium will be paid in instalments, or on a deferred payment date, such as the Exercise Date.

E. *Exercise and Settlement of Options*

1. Section 5.1 states that the Buyer may exercise an Option by delivery to the Seller of a timely Notice of Exercise and that, subject to the automatic exercise provisions contained in Section 5.3, an Option which has not been exercised by its Expiration Time shall expire and become void. Accordingly, market participants should exercise particular care when clocks worldwide are changed seasonally. In addition, it is the Buyer's responsibility to ensure that a Notice of Exercise is addressed to, and received by, the department or area specified by the Seller in Part III of the Schedule to the Master Agreement.

2. Section 5.1(a) reflects the general market practice that the close of business occurs at 3:00 p.m. (local time of the Seller) and that a Notice of Exercise received after that time is deemed received on the next Business Day. In accordance with the definition of "Notice of Exercise", such Notice should be given by telephone or other electronic means, but may not be given by facsimile transmission.

3. Options may be entered into on the understanding that physical delivery of the Put Currency and the Call Currency will *not* take place and that the Option will be net cash settled by a payment to the Buyer of the Option's In-the-money Amount (or intrinsic value) if the Option is exercised. The intrinsic value of an Option will be equal to the difference between the Spot Price and the Strike Price multiplied by the amount of the Put or Call Currency, as appropriate, to be exchanged upon exercise of the Option. Examples of the calculation of the intrinsic value of a United States Dollar/Deutsche Mark Call and Put are as follows:

   For Calls:

   Intrinsic value = (Spot Price – Strike Price) x Call Currency Amount

   If Put Currency and Amount = DEM 1,600,000
   Call Currency and Amount = USD 1,000,000
   Strike Price = 1.60 DEM/USD[2]
   Spot Price = 1.6850 DEM/USD

   Then intrinsic value is:

   (1.6850 DEM/USD – 1.60 DEM/USD) x USD 1,000,000
   = .0850 DEM/USD x USD 1,000,000
   = DEM 85,000

   For Puts:

   Intrinsic value = (Strike Price – Spot Price) x Put Currency Amount

   If Put Currency and Amount = DEM 1,600,000
   Call Currency and Amount = USD 1,000,000

[2] In a Call, the Strike Price and Spot Price are quoted in terms of the amount of the Put Currency per unit of the Call Currency. In a Put, the Strike Price and Spot Price are quoted in terms of the amount of the Call Currency per unit of the Put Currency.

Strike Price = .625 USD/DEM
Spot Price = .60 USD/DEM

Then intrinsic value is:

(.625 USD/DEM - .60 USD/DEM) x DEM 1,600,000
= .0250 USD/DEM x DEM 1,600,000
= USD 40,000

The level of the Spot Price at the time of exercise is, therefore, crucial to the ultimate value of the net cash settlement. As the Spot Price that is used for such purposes is determined in good faith by the Seller, the Buyer should ascertain *at the outset* how the Seller will determine the Spot Price.

4. Section 5.3 provides for automatic exercise of Options which are in-the-money at the Expiration Time and have not been exercised by delivery of a Notice of Exercise, unless otherwise agreed in the Schedule. This provision is *not* meant to be a substitute for the delivery of a Notice of Exercise by the Buyer, which is good market practice and is encouraged. For this reason, (a) an Option will be deemed exercised under this Section only if, at its Expiration Time, it has an In-the-money Amount that equals or exceeds the product of (x) 1% of the Strike Price and (y) the amount of the Call or Put Currency, as appropriate, (b) the Seller determines the Spot Price that is used to calculate the In-the-money Amount, and (c) the Seller may choose to settle an automatically exercised Option either by physical delivery (in accordance with Section 5.4) or net cash settlement (in accordance with Section 5.5). In certain countries, automatic exercise of Options may have adverse tax consequences or may be deemed to affect the "optionality" of an Option transaction, which, in turn, may affect the characterization of the Option under local gaming laws. Parties should consult their counsel before determining whether automatic exercise should apply to them.

5. Because an exercised Option settles on the Spot Date for the Currency Pair, it is common practice for market participants to process an Option which is to be settled by physical delivery as if it were a spot foreign exchange contract, including the exchange of settlement instructions and confirmations. (If confirmations are issued upon the exercise of an Option, it is desirable that such confirmations indicate that the spot foreign exchange transaction relates to an Option exercise.) Notwithstanding such treatment, unless otherwise specified by the parties, an exercised Option remains an Option and the parties' rights and obligations with respect thereto will continue to be governed by the Master Agreement. For example, should an Event of Default occur with respect to a party between the Exercise Date and the Settlement Date for an Option, the counterparty's rights to close out and liquidate such Option (and other Options entered into by the parties) are those set forth in Section 8. Parties wishing to have settlement of an exercised Option be governed by an IFEMA Master Agreement between them may wish to amend Section 2.1 to the following effect: "In the case of exercised Options where settlement will occur by delivery of the Currency Pair, settlement will be governed by the International Foreign Exchange Master Agreement dated [date] between the parties." In this case, Options settled at their In the money Amount would continue to be governed by ICOM.

6. Section 5.2 provides that, unless otherwise agreed by the parties, an Option may be exercised only in whole and not in part.

7. Options are settled by payment of the Put Currency amount by the Buyer to the Seller and by the payment of the Call Currency amount by the Seller to the Buyer. In each case, such payments shall be made in immediately available and freely transferable funds to the bank and account number specified by the recipient of the payment in Part IV of the Schedule attached to the Master Agreement. See Section 11.11.

8. Section 5.5 covers Options that are to be settled at their In the money Amount. The In the money Amount is determined based upon the Spot Price at the time of exercise, or as soon as practicable thereafter. Both traders ideally should agree on the Spot Price. Since Options may be exercised by electronic communication before the opening of business at the Seller's Designated Office, courtesy requires that the Spot Price be determined when the Seller's trader actually receives the Notice of Exercise.

F. *Discharge and Termination of Options*

Section 4 of the Master Agreement provides (unless the parties have provided otherwise in Part V of the Schedule) for the automatic discharge and termination of Call Options written by both parties and Put Options written by both parties, provided that (i) the material terms of such Options are the same, (ii) Premiums with respect to such Options have been paid, and (iii) such Options have not been exercised. The effect of this Section is to net Options in the limited circumstances in which Options can effectively be netted. The sole remaining rights and obligations of the parties with respect to Options discharged and netted under Section 4, are to exercise that portion, if any, of the one of the Options that is not discharged and terminated and to settle such portion upon the exercise thereof, respectively. Section 4 effectively allows counterparties to close out existing Options or to reduce their exposure to each other by entering into offsetting Options. Nevertheless, counterparties are encouraged to close out existing Options or to reduce their exposure to each other primarily by terminating existing Options, rather than entering into new Options, since entering into new Options may, depending upon the enforceability of the netting provisions, double credit exposure and capital usage.

Many Option dealers do not currently terminate offsetting Options, primarily because they do not have the operational capability to do so. Presumably, such parties will agree with their counterparties that offsetting Options will not be discharged or terminated.

G. *Payment Netting*

Section 6 contains two separate payment netting provisions. Section 6.1 provides for the *automatic* netting of any Premium payments that would otherwise be made by the parties in the same currency on the same date. Section 6.2 provides for the netting of any payments, other than Premium payments, to be made by the parties to each other in the same currency on the same date. These provisions do not alter the parties' legal rights and obligations with respect to the underlying Options (as Section 4 does). The intent of this Section is to reduce the number and size of payments required to be made by the parties in connection with their Options transactions. Many Option dealers do not currently net Premium payments, primarily because they do not have the operational capability to do so. Presumably, such parties will agree with their counterparties not to net such payments (either by way of a side agreement or by striking Section 6.1 from the Master Agreement). However, since Premium payment netting reduces settlement exposure and the cost of transacting Options (because of the reduction in the number of payments), Premium payment netting is encouraged.

H. *Default*

1. The provisions of Section 8 should be read carefully and understood as they set forth the rights and obligations of counterparties upon the occurrence of an Event of Default with respect to either of them. (In addition, the close-out and liquidation procedures set forth in Section 8.1 will also be followed in the event that it becomes illegal or impossible for a party to perform its obligations under an Option under the provisions of Section 9 of ICOM.)

2. Section 8.1 sets forth the steps that a Non-Defaulting Party must take in closing out and liquidating Options. It requires that the Non-Defaulting Party close out and liquidate all outstanding Options, except to the extent that such party believes in good faith that applicable law prohibits the close out and liquidation of certain Options. This requirement is intended to support the statement made in Section 2.2 that the Master Agreement and all Confirmations (and, therefore, the Options which they evidence), Schedules and amendments to the Master Agreement constitute a single agreement between the parties. The single agreement concept is intended to prevent cherry picking by a trustee, receiver or conservator of an insolvent Defaulting Party. Close out means that Options are terminated. Liquidation means that a settlement amount is calculated in accordance with Section 8.1. It does not require the Non Defaulting Party to enter into replacement transactions for the terminated transactions. The decision whether to enter into replacement transactions is left

to the Non Defaulting Party. If the Non Defaulting Party determines to enter into replacement transactions, the settlement amount would be based on the cost of such transactions. If the Non Defaulting Party determines not to enter into replacement transactions, the settlement amount would be based on market prices, as reflected in quotations from brokers or dealers or reports or other evidence of actual trades.

Section 8.1 further provides that, in the case of specified Events of Default relating to the insolvency of the Defaulting Party, if "Automatic Termination" is specified as applying to the Defaulting Party in Part X of the Schedule, such liquidation shall be automatic with respect to all outstanding Options. Where the law governing the insolvency proceedings of the Defaulting Party does not expressly allow liquidation to take place after the occurrence of the relevant Event of Default, automatic liquidation is considered preferable as it is less likely to be challenged in the insolvency proceedings of the Defaulting Party. The parties may wish to use Part IX of the Schedule to add other automatic Events of Default if deemed desirable under the bankruptcy laws of any country. Such events might include dissolution, a general assignment or composition for the benefit of creditors, a resolution for winding up, seeking or becoming subject to the appointment of an administrator, liquidator, conservator, receivers, trustee or custodian, analogous events, and other events recommended by local counsel.

3. An Event of Default may occur at several stages in the life of an Option:

(a) An Event of Default may occur with respect to the Buyer after it has paid the Premium for an Option. If the only Options outstanding are those purchased by the Buyer for which the Premium has been paid, an argument may be made that the Options should not be terminated. However, (1) the Seller is still subject to the Buyer's credit risk on the underlying FX Transaction, and (2) since the Buyer will be entitled to receive the market premium, it will not suffer any loss. (The Buyer is not entitled also to receive restitution of any Premium previously paid with respect to a terminated Option.) If the Buyer is both the writer and purchaser of Options, it is also fitting that all Options are closed out and netted.

(b) An Event of Default may occur with respect to the Buyer before it has paid the Premium with respect to one or more Options. Failure to pay Premium is covered by Section 3.2 of the Agreement, which allows the Seller to treat the non payment as an Event of Default or to treat the Option as void. If the Option is void, no Premium is due. If it is treated as a defaulted Option, the Seller is entitled to receive the unpaid Premium.

(c) An Event of Default may occur with respect to the Seller before the Seller has received the Premium. The Purchaser should have the right under contract law to cancel the Option for anticipatory breach. If the Purchaser does not cancel the Option, the Seller should have that right under Section 3.2.

(d) An Event of Default may occur with respect to the Seller after it has received the Premium. Liquidation in this situation is covered in Section 8.1(b)(i)(A).

(e) An Event of Default may occur after an Option has been exercised but before settlement date for the Option. Under Section 8.1(b)(i)(C), each party is entitled to receive any unpaid amount due in settlement of the Option, with interest from the due date.

In the event that the close out formula does not compensate the Non Defaulting Party for all its costs and losses, including its cost of funding, its cost of terminating or re establishing a hedge or the loss of its bargain, paragraph (D) allows it to add the amount of such loss as determined by it reasonably and in good faith.

4. Clause (i) of Section 8.1(b) provides for the calculation and aggregation of settlement amounts for each party for each Option closed out. The Non-Defaulting Party should endeavour to value all outstanding Options on a single day. However, if this is impracticable, the calculation of the settlement amount should be completed as soon as practicable. With respect to Options purchased by a party, the settlement amount will be the current market premium (or replacement cost) for such Options. With respect to Options

sold by a party, the only settlement amount will be any unpaid Premium and any interest on such unpaid Premium. With respect to exercised, but unsettled, Options, the settlement amount will be the unpaid settlement amount plus interest thereon. In addition, the Non-Defaulting Party is entitled to include any costs or expenses incurred in covering its obligations related to such liquidated Options, such as the obligations on a Delta hedge. The determination of a settlement amount for each party in each instance must be made in good faith. Attached to this Guide is an example of a close out under ICOM Terms.

5. After calculation of each party's settlement amount, clause (ii) of Section 8.1(b) provides for the conversion of such amount into the Non-Defaulting Party's Base Currency. As such settlement amount may be in different currencies (corresponding to the different currencies in which Premiums and unpaid settlement amounts with respect to exercised Options were paid or payable), it is necessary to convert all such settlement amounts into a single currency if such amounts are to be aggregated (and netted pursuant to the provisions of clause (iii) of Section 8.1(b)). In addition, the Non-Defaulting Party is given the benefit of converting this settlement amount into its Base Currency (rather than the Defaulting Party's Base Currency). For purposes of this conversion, the Non-Defaulting Party should use the applicable Spot Rate.

6. Following the conversion and aggregation of each party's settlement amount, clause (iii) of Section 8.1(b) provides that such settlement amount will be netted, resulting in a single liquidated amount in the Non-Defaulting Party's Base Currency that will be due and payable as a settlement payment to the party having the larger aggregated settlement amount.

7. If one or both of the parties are holding any cash or non-cash collateral as margin or security for their respective obligations under outstanding Options or the Master Agreement generally, Section 8.2 allows the parties to set off the value thereof (following any necessary conversion into the Non-Defaulting Party's Base Currency) against the liquidated damage amount calculated under the preceding clauses.

8. Section 8.4 provides for the payment of the net amount calculated pursuant to Section 8.1 and Section 8.3. The Non Defaulting Party is to send the Defaulting Party a notice of its close out calculation as of the Close-Out Date or as soon as reasonably practicable thereafter. Payment by the Defaulting Party of the settlement amount, with interest, is due by the close of business on the Business Day following receipt of such notice. In some countries, a judgment can only be rendered in the currency of that country. Therefore, Section 8.4 provides that, if required by applicable law, the net amount payable by one party to the other will be converted into a currency other than the Non-Defaulting Party's Base Currency. Any costs of such conversion will be borne by the Defaulting Party. If this amount is not paid when due, Section 8.4 provides for the payment of interest at overnight LIBOR in the Non Defaulting Party's Base Currency for each day for which the amount remains unpaid. Section 8.8 also provides that Section 8 is not intended to limit, but rather that the rights provided for therein shall be in addition to, any other rights which the Non-Defaulting Party may have under applicable law, by agreement or otherwise, and that the Non-Defaulting Party is granted a general right of set-off with respect to all amounts owed by either party to the other, whether due or not due.

9. Section 8.5 establishes the right of one party to suspend performance of its obligations under any Option or the Master Agreement (i) if the counterparty is currently in default in the payment or performance of any of its obligations under an Option or the Master Agreement or (ii) during the pendency of a reasonable request to the counterparty to provide adequate assurances of its ability to perform such obligations. The default need not constitute an Event of Default. Therefore, if a Buyer has not paid a Premium on the applicable Premium Payment Date, even though the Seller has not sent written notice of non receipt (or, if such notice has been sent, but two Business Days have not elapsed), the Seller is, nonetheless, entitled to suspend its performance with respect to other Options between the parties until receipt of such Premium.

I. Force Majeure, Illegality, and Impossibility

Section 9.1 provides that, if either party is unable to perform, or is hindered or delayed in performing, its obligations in respect of any Option due to force majeure, or if it otherwise becomes illegal or impossible for either party to perform its obligations in respect of any Option, then either party may, after notice of the occurrence of such event, liquidate and close-out all affected Options. Although such events do not constitute Events of Default, the liquidation and close-out procedures to be followed are those provided for in Section 8. Either of the parties may take such action promptly upon notice to the other. Due to the volatile nature of the Option markets, it is important that the parties have the ability to liquidate positions promptly in order to limit their exposure to transactions which one of the parties may be unable to perform. If Section 9 is applicable to the obligations of both parties, the parties should mutually agree upon the close-out and liquidation of Options.

Section 9.2 provides that, if Section 9.1 becomes applicable, the party which is unable to perform must use all reasonable efforts to transfer the affected Options to another of its Designated Offices, unless prohibited by law. Such transfer requires the consent of the other party. Such transfer will not be required if the party unable to perform would incur a loss other than immaterial, incidental expenses or the transfer would cause the other party to incur a material tax or other cost.

J. Parties to Rely on Their Own Expertise

Section 10 establishes that each of the parties has relied on its own expertise and judgment in entering into each Option and as to all other subsequent actions or matters related thereto or any other currency option or transaction. The intent of this provision is to protect each of the parties from a claim or action by the other party wherein it is alleged that one of the parties exercised influence or control over the decisions or actions of the other to the extent that it is, therefore, liable for losses, costs, expenses or damages suffered or incurred as a result of such decisions or actions.

K. Miscellaneous

1. The intent of Section 11.1 is to insure that any settlement payment to a party resulting from the termination and liquidation of Options arising either as a result of an Event of Default or an event of illegality, impossibility or force majeure, and whether pursuant to the operation of Section 8 or the judgment of a court, is made in such party's Base Currency (or the Non-Defaulting Party's Base Currency) and is paid in the full amount in such Base Currency. If payment is made in some other currency, such payment is deemed to discharge the obligation of the payor only to the extent that the payee could purchase the full amount of the Base Currency (or the Non-Defaulting Party's Base Currency) with the amount of the currency received on the business day following the date of receipt. If the amount of the currency received is insufficient to purchase the full amount of the Base Currency, the payor indemnifies the payee against any loss and, in any event, the payor indemnifies the payee against any costs incurred in purchasing the Base Currency.

2. Pursuant to Section 11.3, the parties agree to the tape recording of any telephone conversations between them and agree that such tape recordings can be submitted in evidence in any proceeding relating to any Option transaction. It is standard market practice that conversations between traders and between traders and brokers are recorded. This practice is encouraged, as such recordings can substantially reduce the number of disputes that arise between market participants and the time which it takes to resolve such disputes.

3. Under Section 11.12, amendments to the Agreement are normally effective only if executed in writing by each of the parties. The parties may, however, agree in a Confirmation to amend the Agreement solely with respect to the Option that is the subject of the Confirmation. Such a Confirmation is effective if sent by mail, telex, facsimile or other electronic means from which it is possible to produce a hard copy, even if not signed. Section 11.12 is consistent with Section 2.4, which provides that, in the event of an inconsistency between the Agreement and a Confirmation, the Confirmation prevails. The only subjects

that cannot be changed in a Confirmation are the method of confirming Options and whether Options may be discharged under Section 4.

4. Some parties may choose to deal Options with each other on a margined or secured basis. Section 11.13 provides that, if the parties have entered into an agreement providing for such dealings, then such agreement is incorporated into the Master Agreement and is subject to the terms thereof. The possibility of such an arrangement is also addressed in Section 8.2, which provides for the set-off of any collateral held as margin or security against the settlement payment otherwise calculated pursuant to Section 8.1. If the margin or security agreement conflicts with the Master Agreement, the Master Agreement would govern.

L. Law and Jurisdiction

1. Counsel has opined with respect to Old ICOM that the form of Master Agreement is valid and enforceable under the laws of both the State of New York and the laws of England and Wales. The Working Party and the Financial Markets Lawyers Group expect to obtain updated enforceability opinions from time to time. It is expected that counterparties, and especially those physically located in either the U.K. or the U.S.A., will choose one of these systems of law to govern the Master Agreement and all Options entered into by the parties. It is also expected that parties will submit to the jurisdiction of either the courts in the State of New York or England consistent with their choice of governing law. However, as such submission to jurisdiction is non-exclusive, parties will be free to bring actions, suits or proceedings in other jurisdictions.

2. Pursuant to Section 12.4, each party explicitly waives any sovereign immunity it may be entitled to assert in any legal proceeding arising out of the Master Agreement.

M. Currency Option Confirmation

1. The recommended form of Confirmation, which is attached to this Guide as an example, is substantially the same as the form of confirmation generally used by market participants to evidence options. All of the material terms of an Option are to be set forth in the Confirmation. Material terms which are not otherwise required to be specified in the Confirmation should be included in the "Other terms and conditions" section.

2. There are three headings in the form of Confirmation which are not used or defined in the Master Agreement – Trade Date, Expiration Settlement Date and Price.

   The Trade Date is the day on which the parties agree to enter into an Option.

   The Expiration Settlement Date is the last possible day on which an exercised Option could settle. In keeping with market practice, this will generally be the Spot Date for the Currency Pair as determined on the Expiration Date.

   Price is the currency exchange rate or the percentage (of one of the Currency Pair) upon which the Premium of an Option is determined. See Section II.A above for an explanation of market practice with respect to price quotation.

3. Where dates are to be specified in the Confirmation (e.g. Trade Date), the market convention is to specify the day first (using two numbers), the month second (using three letters) and, finally, the year (using two numbers, being the last two numbers of the applicable year). For example, the date March 10, 1997 would be specified as "10/MAR/97".

N. Schedule

Each of the parties may complete a Schedule in the form attached to the Master Agreement Terms. The Schedule contains particulars concerning each party, such as the address, telephone, telex and facsimile number, and contact person for notices and other communications, and each party's Base Currency. In addition, in Part II of the Schedule, the parties should designate their branches or offices whose transactions and dealings are intended to be covered by the Master Agreement.

Either because of concerns with respect to applicable law or operational capabilities (which, for instance, may make the settlement, payment netting or set-off of Options between certain offices of the counterparties difficult), counterparties may choose to limit the number of Designated Offices covered by a particular Master Agreement and may choose to put in place more than one Master Agreement between them, each covering a different set of Designated Offices.

ICOM contains a number of new Schedule Parts, to enable the parties to tailor the Agreement to their particular needs. For example, Part V allows the parties to determine whether exactly offsetting Options will be discharged pursuant to Section 4 of the Agreement. Part VI allows the parties to determine if they wish Options to be exercised automatically if they are in the money by a specific amount or percentage. Part VIII enables the parties to choose a Threshold Amount for cross defaults. Part X allows them to determine whether Automatic Termination will apply to one or both of the parties. The parties may determine in Part XI whether they will be obligated to give "adequate assurances" of their ability to perform. Part IX allows the parties to add additional Events of Default, and Part XV allows them to add additional representations with respect to certain U.S. regulatory matters. Part XIV allows a party whose residence is not the same as its counterparty's to designate an agent for service of process.

O. *The Barrier Option Addendum ("Barrier Addendum")*

1. A Barrier Options Subcommittee of the Working Committee/Financial Markets Lawyers Group has developed forms which are recommended for use with Barrier Options. There is a Barrier Option Addendum to a Master Agreement Schedule, a short form Confirmation for use with such Addendum, and two long form confirmations for use where the parties have not executed such a Barrier Option Addendum. Copies are included herewith. The Barrier Addendum should be executed where the parties intend to enter into Barrier Options (e.g. Knock In and Knock Out Options). It contains definitions and other provisions which set forth the rights of the parties in relation to such Options. The Barrier Addendum has been prepared as a schedule to ICOM, although it could clearly be modified to serve as a schedule to another form of Master Agreement.

2. In each Barrier Option, the parties are expected to name a "Barrier Determination Agent", which will usually be either the Buyer or Seller. Some market participants suggested that the Barrier Determination Agent be the "non aggressor" or the "market maker", i.e. the party which provided the price quotation for the Option. The Barrier Option Subcommittee believed that these terms were vague, since the "market maker" may change from transaction to transaction between the same two parties. Consequently, good practice demands that the Barrier Determination Agent for each Option be designated in the Confirmation.

3. It is the responsibility of the Barrier Determination Agent to determine whether a barrier has been breached, which determination must be made in good faith and in a commercially reasonable manner. There are a number of prerequisites for transactions which will be deemed to breach a barrier:

   (a) They must be actual transactions in the foreign exchange markets. Quotations, whether firm or indicative, obtained from a foreign exchange broker or dealer or a quotation screen or other information source which does not provide evidence of an actual transaction, are not acceptable evidence that a barrier has been breached. The Barrier Option Subcommittee rejected a suggestion that an independent source of price quotations (e.g. three independent dealers) be used, because time is of the essence to both parties, so that they may avoid economic losses related to purchasing or selling hedges in rapidly moving and sometimes whipsawing spot markets, and obtaining independent price quotations is often time consuming.

   (b) Transactions known to be at off market prices are not evidence that a barrier has been breached.

   (c) Transactions must occur between 6:00 a.m. Sydney time on Monday and 5:00 p.m. New York time on Friday. Trades occurring outside those hours are never included, even if there is an active foreign exchange market outside of those hours (for

example, because of a particular world event). Trades are considered valid even if they occur on a holiday in the country where the trade takes place.

(d) Transactions must of commercial size (the amount which is generally accepted by foreign exchange dealers for the applicable currency). The parties may wish, in the case of large transactions, to specify a larger minimum size for the breaching transaction, since Options may be exercised only in whole and not in part, and the existence of a single trade of commercial size may not indicate the ability to cover the exercise of the entire Option.

(e) Breaching transactions may include transactions of the Barrier Determination Agent with third parties, but not with its affiliates or other parties who are not dealing at arm's length or otherwise are not providing good faith fair market prices.

4. The Barrier Addendum provides that a Knock In Event or Knock Out Event has occurred if the Spot Exchange Rate is equal to or "beyond" the In Strike or Out Strike Price. The direction indicated by the term "beyond" will depend upon (a) the Initial Spot Rate (i.e. the Spot Rate at the time the Option was entered into), and (b) whether the Option is an "up and in", "up and out", "down and in" or "down and out" Barrier Option.

5. The Barrier Addendum contains a definition of the term "Initial Spot Rate". The Initial Spot Rate is not an operational term which is necessary for a Barrier Option. Nonetheless, the members of the Barrier Option Subcommittee believe the term should be included in Barrier Option Confirmations, since it is helpful for potential dispute resolution and risk management purposes. For example, to determine whether two Options with the same trade details (i.e. same strike, same type, same maturity and same out-strike or in strike) are down and out calls or up and out calls, the parties must either specify the exact nature in the confirmation or indicate the level of spot rates at the time the Option was transacted. However, simply identifying the nature of the Option can be misleading. For example, a 1.40 DEM put that was transacted when the spot rate was 1.48 and knocks out when spot gets to or through 1.47 would usually be described as an up and out DEM put, despite the fact that 1.47 is lower than 1.48. Good practice therefore suggests that the Initial Spot Rate at the time of the transaction be provided.

6. Under the Barrier Addendum, the Barrier Determination Agent is required to inform the other party (or the parties, if the Barrier Determination Agent is not one of the parties) of the occurrence of a Knock In or Knock Out Event. Good practice requires that, upon request of one of the parties, the Barrier Determination Agent provide evidence of the trade which breaches the barrier. Such evidence may include a taped telephone conversation, a written confirmation of a transaction, a printout of a trading screen or a quotation in writing, and may include evidence provided by the counterparty. The existence of a dispute between the parties over whether a barrier has indeed been breached does not affect the validity of the Barrier Determination Agent's determination that a barrier has been breached unless the Barrier Determination Agent itself decides, based upon a re assessment of the available price information and information provided by the counterparty, that it is no longer able to conclude in good faith that the barrier has been breached.

7. The Barrier Addendum provides that Knock In Options may be either American or European Style Options, as specified in the applicable Confirmation. Knock Out Options must be European Options; they may be exercised only on the Expiration Date at the Expiration Time and provided that no Knock Out Event has occurred at or prior to the time of exercise. In the case of Knock Out Options, the parties may choose to use an Exercise Window. If there is no Exercise Window, a Buyer may give notice of exercise prior to the Expiration Time, but such notice will not be effective if a Knock Out Event occurs thereafter prior to the Expiration Time. If the parties have chosen to use an Exercise Window Period, then the Buyer may give notice of exercise up to one hour prior to the Expiration Time, and such notice will be effective even if the barrier is breached between the time of the Notice and the Expiration Time. Nevertheless, a Notice of Exercise is irrevocable once given, notwithstanding the existence of an Exercise Window. An Exercise Window is sometimes considered to be desirable operationally.

8. The Barrier Addendum definition of "Spot Exchange Rate" includes cross rates. A cross rate is determined from two other exchange rates, e.g. the yen/DM rate may be derived from the yen/dollar rate and the dollar/DM rate. If the parties do not wish cross rates to be used to determine if a barrier has been breached (but instead to use only actual trades in the relevant currencies), it will be necessary to amend the definition of Spot Exchange Rate in the Schedule or to so specify in a Confirmation. It is the intention of the Barrier Option Subcommittee that a party using one or more cross rates to determine if a barrier has been breached must comply with a standard of "good faith" and in a "commercially reasonable manner".

9. The Barrier Addendum states that, unless otherwise agreed, a purchase and sale of the identical Barrier Option will not be offset and discharged under Section 4 of the Master Agreement. Parties wishing such Options to be offset should delete this provision. It should be noted that, in addition to the factors listed in Section 4 of the Agreement that must be present in both Options, two Barrier Options may be discharged only if they have the same Barrier Determination Agent.

10. A user of the Barrier Addendum may wish to consider whether it would be appropriate to disclose to its counterparty that its ordinary course foreign exchange transactions and its activities in hedging or de hedging its position under a barrier option may increase the probability that a knock in or knock out event will occur. Such disclosure might be added to the Barrier Addendum or to Confirmations for particular transactions, or might be provided in a separate disclosure statement sent to the counterparty before the commencement of transactions in barrier options, so that the disclosure may be tailored to the level of sophistication of the counterparty. Such disclosure might include all of part of the following:

    (a) As part of its business, it regularly trades in the foreign exchange spot, forward, futures and options markets for its own account and for the accounts of other customers. Such trading may affect spot prices in the Currency Pair.

    (b) It generally hedges its Barrier Option positions by buying or selling a quantity of the relevant currency, and may adjust (increase or decrease) its hedge as market conditions change during the life of the Options and it believes that it is more or less likely that a Barrier will be breached. Such hedging and de hedging activity may affect spot prices and may thus affect the probability of a barrier being breached.

    All Option counterparties are expected to act honestly and in good faith. Use of such disclosure language does not justify foreign exchange transactions that are undertaken to manipulate the Spot Exchange Rate and not as part of bona fide, good faith foreign exchange transactions, hedging or de hedging.

International Currency Options Market Close Out Example

Bank A, a U.S. bank ("Party A"), and Corporation B, a French corporation ("Party B"), have signed a New ICOM Agreement or otherwise have an agreement subject to New ICOM terms (in either case, the "Agreement"). Party A's Base Currency is the U.S. Dollar.

Party B files for bankruptcy on September 1, 1995 (a Friday). Party A learns of the bankruptcy on Tuesday, September 5. (Monday, September 4, was Labor Day, a U.S. bank holiday). In Part IX of the Schedule to the Agreement, the Parties have chosen "Automatic Termination" upon an Event of Default.

At the time of the bankruptcy filing, the parties had six unexercised Options and one partly performed exercised Option as follows (the FMV amounts in parentheses represent the current bid ask spread for an equivalent Option on September 5, 1995):

1. B sold to A for 100 (premium due 12/1/95)(FMV 90 95 bid ask)

2. B sold to A for 100 (FMV 90 95)

3. B sold to A for 100 (FMV 110 115)

4. A sold to B for 100 (premium due 8/15/95 and is past due)(FMV 110 115)

5. A sold to B for 100 (premium due 12/1/95)(FMV 105 110)

6. A sold to B for 100 (FMV 95 100)

7. B sold to A for 100. A exercised the option (yen/DEM) on August 25. Resulting trade should have closed on August 29 [the 27th was a Sunday]. A delivered 730,900,000 yen in Tokyo on August 29, but the 10 million DEM were never delivered.

Termination

Because the Parties chose Automatic Termination under Section 8.1, all Options were terminated automatically on September 1 as of the time immediately preceding the institution of the bankruptcy proceeding. Section 8.1(i) requires Party A (the Non Defaulting Party) to calculate in good faith, as of the Close out Date or as soon as reasonably practicable thereafter, a settlement amount for each Party. Although the Close out Date was September 1, it probably will not be practicable for Party A to do its close out calculations as of September 1, because (a) option prices as of September 1 may not be available on September 5, and (b) the market may have moved between September 1 and September 5 (since September 4 was a Business Day outside the U.S.), and September 5 prices will be a more accurate reflection of the cost to Party A of replacing the terminated Options.

Determining the Settlement Amount for Party A's Options

Party A bought the first three Options. Section 8.1(i)(a) states that the settlement amount for each Option is the current market premium for the Option (in the case of an Option purchase, the offer side).

Option 1. Party A is entitled to the current market premium = 95. [8.1(i)(a)]

Option 2. Party A is entitled to the current market premium = 95. [8.1(i)(a)]

Option 3. Party A is entitled to the current market premium = 115. [8.1(i)(a)]

Party A sold the next three options. Section 8.1(i)(b) states that the settlement amount of each Option is any unpaid Premium.

Option 4. The Premium was due on August 15. Is there an Option? Under Section 3.2(ii), Party A had the right, within 48 hours after the Premium Payment Date, to terminate the Option or declare an Event of Default. It apparently did not terminate the Option, so it must have decided to accept late payment. Accordingly, there is an Option, and Party A is entitled to the overdue Premium ($100) with interest from August 15 to but excluding September 1 at 1% over Party A's Funding Rate. [8.1(i)(b)].

Option 5. There is $100 in unpaid Premium, which is not due until December 1. Party A is entitled to $100 discounted from December 1 to but not including September 1 at 1% over Party A's Funding Rate. [8.1(i)(b)]

Option 6. Premium has been paid. Party A is entitled to 0.

Option 7. Party A is owed the DEM 10 million plus interest from August 29 to September 1 at a rate equal to 1% over Party A's Funding Rate, which will be it's cost to fund that amount of DEM.

Party A is entitled to any additional losses determined under Section 8.1(d).

The Premium payments owed to Party A are apparently already denominated in U.S. Dollars. Thus there is no need to convert the aggregate Premium amounts set forth above into dollars, which is Party's A's Base Currency, in accordance with Section 8.1(ii). However, Party B owes Party A DEM 10 million, which must be converted into Party A's Base Currency of USD. At the exchange rate at which Party A could have bought USD with DEM on September 5, 1995, this amount is approximately $7,028,889.

Determining the Settlement Amount for Party B's Options

Party B sold the first three options. It is entitled to any unpaid Premium, with interest to the payment date if the Premium is overdue, or discounted from the Premium Payment Date, if the Premium is not yet due.

Option 1. The Premium is not due until December 1. Party B is owed $100 Premium, discounted from December 1 to but not including September 1, at LIBOR on September 1. [8.1(i)(b)].

Option 2. Party B has already received the Premium, so the settlement amount = 0.

Option 3. Party B has already received the Premium, so the settlement amount = 0.

Party B purchased the next three Options, and is entitled to the current market premium.

Option 4. Party B is entitled to the current market premium for the Option = 115.

Option 5. Party B is entitled to the current market premium for the Option = 110

Option 6. Party B is entitled to the current market premium for the Option = 100

Option 7. Party B has already been paid with respect to the FX Transaction that resulted from the Option exercise, so settlement amount = 0

No currency amounts need to be converted to Party A's Base Currency.

Netting of Settlement Amounts

After settlement amounts are calculated for each Option, a net amounts must be derived. The net amount in the above example is shown on the following chart:

	Party A	Party B
Option 1	$95	$100 discounted
Option 2	$95	0
Option 3	$115	0
Option 4	$100 plus interest	$115
Option 5	$100 discounted	$110
Option 6	0	$100
Option 7	$7,028,889	0
Total	$505 + $7,028,889	$425
Total	$7,108,889	

Set off against Credit Support

If there were a Credit Support Agreement between the Parties, Party A would be entitled to set off the amount owed it against the amount of any collateral held by it. There is no such collateral in this case.

Notice of Settlement Calculation

Under Section 8.3, Party A should send Party B a notice of its calculation of the settlement amount. If Party B received such notice on September 5, it would be obligated to pay to Party A, on September 6, the net settlement amount with interest at Party A's Funding Rate from September 1 to but excluding September 6. To the extent such amount were not paid on September 6, it would bear interest at 1% over Party A's Funding Rate.

HEADING SHEET

Parties wishing to record their entry into a Master Agreement on these Master Terms in hard copy may utilise this heading sheet to create their Master Agreement.

If this heading sheet is utilised, the signing sheet, to be found at the end of the Master Agreement Terms on page 53, shall also be completed.

International Currency Options Master Agreement

MASTER AGREEMENT dated as of[a] .... by and between

b ...., a[c] ....

of[d] .... and

[c] ...., a[c] ....

of[d] ....

---

[a] insert day of month and year

[b] insert name of party

[c] insert type of body (e.g. company)

[d] insert place of establishment

[c] insert name of counterparty

1997 International Currency Options Market Master Agreement Terms

Section 1. Definitions

Unless otherwise required by the context, the following terms shall have the following meanings in the Agreement:

"*Agreement*" has the meaning given to it in Section 2.2, and, unless otherwise agreed in writing by the Parties, the Agreement shall arise between the Parties where, and as soon as, these Terms are applied to an Option by virtue of Section 2.1 (a).

"*American Style Option*" means an Option which may be exercised on any Business Day up to and including the Expiration Time.

"*Base Currency*", as to a Party, means the Currency agreed to as such in relation to it by agreement in writing between the Parties or, failing any such agreement in writing, Pounds Sterling.

"*Business Day*" means for purposes of: (i) Section 3.2, a day which is a Local Banking Day for the applicable Designated Office of the Buyer; (ii) Section 5.1 and the definition of American Style Option, a day which is a Local Banking Day for the applicable Designated Office of the Seller; (iii) clauses (i), (viii) and (xii) of the definition of Event of Default, a day which is a Local Banking Day for the Non Defaulting Party; (iv) solely in relation to delivery of a Currency, a day which is a Local Banking Day in relation to that Currency; and (v) any other provision of the Agreement, a day which is a Local Banking Day for the applicable Designated Offices of both Parties; provided, however, that neither Saturday nor Sunday shall be considered a Business Day for any purpose.

"*Buyer*" means the owner of an Option.

"*Call*" means an Option entitling, but not obligating (except upon exercise), the Buyer to purchase from the Seller at the Strike Price a specified quantity of the Call Currency.

"*Call Currency*" means the Currency agreed to as such at the time an Option is entered into, as evidenced in a Confirmation.

"*Close Out Date*" means a day on which, pursuant to the provisions of Section 8.1, the Non Defaulting Party closes out Options, or such close out occurs automatically.

"*Confirmation*" means a writing (including telex, facsimile or other electronic means from which it is possible to produce a hard copy) evidencing an Option, and specifying:

(i) the Parties thereto and the Designated Offices through which they are respectively acting,

(ii) whether the Option is a Call or a Put,

(iii) the Call Currency and the Put Currency that are the subject of the Option and their respective quantities,

(iv) which Party is the Seller and which is the Buyer,

(v) the Strike Price,

(vi) the Premium and the Premium Payment Date,

(vii) the Expiration Date,

(viii) the Expiration Time,

(ix) whether the Option is an American Style Option or a European Style Option, and

(x) such other matters, if any, as the Parties may agree.

"*Credit Support*" has the meaning given to it in Section 8.2

"*Credit Support Document*", as to a Party (the "first Party"), means a guarantee, hypothecation agreement, margin or security agreement or document, or any other document containing an obligation of a third party ("Credit Support Provider") or of the first Party in favour of the other Party supporting any obligations of the first Party under the Agreement.

"*Credit Support Provider*" has the meaning given to it in the definition of Credit Support Document.

"*Currency*" means money denominated in the lawful currency of any country or the Ecu.

"*Currency Pair*" means the two Currencies which potentially may be exchanged upon the exercise of an Option, one of which shall be the Put Currency and the other the Call Currency.

"*Custodian*" has the meaning given to it in the definition of Insolvency Proceeding.

"*Defaulting Party*" has the meaning given to it in the definition of Event of Default.

"*Designated Office(s)*", as to a Party, means the office(s) agreed between the Parties to be its Designated Office(s) for the purposes of the Agreement, but in the absence of any such agreement, whenever on or after the Effective Date the Parties enter into an Option in which at least one of them is acting through an office in the United Kingdom, then (unless at the time there subsists a netting agreement between the two offices through which the Parties are respectively acting) each of the offices through which the parties are respectively acting in relation to that Option shall thereby become a Designated Office for the purposes of these Terms (and for these purposes a 'netting agreement' means an agreement applicable to Options containing provisions having a broadly similar effect to the effect of Section 8.1 of these Terms).

"*Effective Date*" means the date agreed in writing between the Parties to be the Effective Date for the purposes of the Agreement, or, in the absence of any such written agreement, the date designated as such for the purposes of these Terms by the British Bankers' Association.

"*European Style Option*" means an Option for which Notice of Exercise may be given only on the Option's Expiration Date up to and including the Expiration Time, unless otherwise agreed.

"*Event of Default*" means the occurrence of any of the following with respect to a Party (the "Defaulting Party", the other Party being the "Non Defaulting Party"):

(i) the Defaulting Party shall (A) default in any payment when due under the Agreement (including, but not limited to, a Premium payment) to the Non Defaulting Party with respect to any Option and such failure shall continue for two (2) Business Days after the Non Defaulting Party has given the Defaulting Party written notice of non payment, or (B) fail to perform or comply with any other obligation assumed by it under the Agreement and such failure is continuing thirty (30) days after the Non Defaulting Party has given the Defaulting Party written notice thereof;

(ii) the Defaulting Party shall commence a voluntary Insolvency Proceeding or shall take any corporate action to authorize any such Insolvency Proceeding;

(iii) a governmental authority or self regulatory organization having jurisdiction over either the Defaulting Party or its assets in the country of its organization or principal office (A) shall commence an Insolvency Proceeding with respect to the Defaulting Party or its assets or (B) shall take any action under any bankruptcy, insolvency or other similar law or any banking, insurance or similar law or regulation governing the operation of the Defaulting Party which may prevent the Defaulting Party from performing its obligations under the Agreement as and when due;

(iv) an involuntary Insolvency Proceeding shall be commenced with respect to the Defaulting Party or its assets by a person other than a governmental authority or self regulatory organization having jurisdiction over either the Defaulting Party or its assets in the country of its organization or principal office and such Insolvency Proceeding (A) results in the appointment of a Custodian or a judgment of insolvency or bankruptcy or the entry of an order for winding up, liquidation, reorganization or other similar relief, or (B) is not dismissed within five (5) days of its institution or presentation;

(v) the Defaulting Party is bankrupt or insolvent, as defined under any bankruptcy or insolvency law applicable to it;

(vi) the Defaulting Party fails, or shall otherwise be unable, to pay its debts as they become due;

(vii) the Defaulting Party or any Custodian acting on behalf of the Defaulting Party shall disaffirm, disclaim or repudiate any Option;

(viii) any representation or warranty made or given or deemed made or given by the Defaulting Party pursuant to the Agreement or any Credit Support Document shall prove to have been false or misleading in any material respect as at the time it was made or given or deemed made or given and one (1) Business Day has elapsed after the Non Defaulting Party has given the Defaulting Party written notice thereof;

(ix) the Defaulting Party consolidates or amalgamates with or merges into or transfers all or substantially all its assets to another entity and (A) the creditworthiness of the resulting, surviving or transferee entity is materially weaker than that of the Defaulting Party prior to such action, or (B) at the time of such consolidation, amalgamation, merger or transfer the resulting, surviving or transferee entity fails to assume all the obligations of the Defaulting Party under the Agreement by operation of law or pursuant to an agreement satisfactory to the Non Defaulting Party;

(x) by reason of any default, or event of default or other similar condition or event, any Specified Indebtedness (being Specified Indebtedness of an amount which, when expressed in the Currency of the Threshold Amount, is in aggregate equal to or in excess of the Threshold Amount) of the Defaulting Party or any Credit Support Provider in relation to it: (A) is not paid on the due date therefor and remains unpaid after any applicable grace period has elapsed, or (B) becomes, or becomes capable at any time of being declared, due and payable under agreements or instruments evidencing such Specified Indebtedness before it would otherwise have been due and payable;

(xi) the Defaulting Party is in breach of or default under any Specified Transaction and any applicable grace period has elapsed, and there occurs any liquidation or early termination of, or acceleration of obligations under, that Specified Transaction or the Defaulting Party (or any Custodian on its behalf) disaffirms, disclaims or repudiates the whole or any part of a Specified Transaction;

(xii) (A) any Credit Support Provider of the Defaulting Party or the Defaulting Party itself fails to comply with or perform any agreement or obligation to be complied with or performed by it in accordance with the applicable Credit Support Document and such failure is continuing after any applicable grace period has elapsed; (B) any Credit Support Document relating to the Defaulting Party expires or ceases to be in full force and effect prior to the satisfaction of all obligations of the Defaulting Party under the Agreement, unless otherwise agreed in writing by the Non Defaulting Party; (C) the Defaulting Party or any Credit Support Provider of the Defaulting Party (or, in either case, any Custodian acting on its behalf) disaffirms, disclaims or repudiates, in whole or in part, or challenges the validity of, any Credit Support Document; (D) any representation or warranty made or given or deemed made or given by any Credit Support Provider of the Defaulting Party pursuant to any Credit Support Document shall prove to have been false or misleading in any material respect as at the time it was made or given or deemed made or given and one (1) Business Day has elapsed after the Non Defaulting Party has given the Defaulting Party written notice thereof; or (E) any event set out in (ii) to (vii) or (ix) to (xi) above occurs in respect of any Credit Support Provider of the Defaulting Party; or

(xiii) any other condition or event agreed in writing between the parties to be an Event of Default applicable to the Agreement.

"*Exercise Date*", in respect of any Option, means the day on which a Notice of Exercise received by the applicable Designated Office of the Seller becomes effective pursuant to Section 5.1.

"*Expiration Date*", in respect of any Option, means the date agreed to as such at the time the Option is entered into, as evidenced in a Confirmation.

"*Expiration Time*", in respect of any Option, means the latest time on the Expiration Date on which the Seller must accept a Notice of Exercise as agreed to at the time the Option is entered into, as evidenced in a Confirmation.

"*In the Money Amount*" means (i) in the case of a Call, the excess of the Spot Price over the Strike Price, multiplied by the aggregate amount of the Call Currency to be purchased under the Call, where both prices are quoted in terms of the amount of the Put Currency to be paid for one unit of the Call Currency; and (ii) in the case of a Put, the excess of the Strike Price over the Spot Price, multiplied by the aggregate amount of the Put Currency to be sold under the Put, where both prices are quoted in terms of the amount of the Call Currency to be paid for one unit of the Put Currency.

"*Insolvency Proceeding*" means a case or proceeding seeking a judgment of or arrangement for insolvency, bankruptcy, composition, rehabilitation, reorganization, administration, winding up, liquidation or other similar relief with respect to the Defaulting Party or its debts or assets, or seeking the appointment of a trustee, receiver, liquidator, conservator, administrator, custodian or other similar official (each, a "Custodian") of the Defaulting Party or any substantial part of its assets, under any bankruptcy, insolvency or other similar law or any banking, insurance or similar law governing the operation of the Defaulting Party.

"*LIBOR*", with respect to any Currency and date, means the average rate at which deposits in the Currency for the relevant amount and time period are offered by major banks in the London interbank market as of 11:00 a.m. (London time) on such date, or, if major banks do not offer deposits in such Currency in the London interbank market on such date, the average rate at which deposits in the Currency for the relevant amount and time period are offered by major banks in the relevant foreign exchange market at such time on such date as may be determined by the Party making the determination.

"*Local Banking Day*" means

(i) for any Currency, a day on which commercial banks effect deliveries of that Currency in accordance with the market practice of the relevant foreign exchange market, and (ii) for any Party, a day in the location of the applicable Designated Office of such Party on which commercial banks in that location are not authorized or required by law to close.

"*Non Defaulting Party*" has the meaning given to it in the definition of Event of Default.

"*Notice of Exercise*" means telex, telephonic or other electronic notification (excluding facsimile transmission) providing assurance of receipt, given by the Buyer prior to or at the Expiration Time, of the exercise of an Option, which notification shall be irrevocable.

"*Option*" means a currency option, which is or shall become subject to the Agreement.

"*Parties*" means the parties to the Agreement, including their successors and permitted assigns (but without prejudice to the application of clause (ix) of the definition of Event of Default); and the term "Party" shall mean whichever of the Parties is appropriate in the context in which such expression may be used.

"*Premium*", in respect of any Option, means the purchase price of the Option as agreed upon by the Parties, and payable by the Buyer to the Seller thereof.

"*Premium Payment Date*", in respect of any Option, means the date on which the Premium is due and payable, as agreed to at the time the Option is entered into, as evidenced in a Confirmation.

"*Proceedings*" means any suit, action or other proceedings relating to the Agreement or any Option.

"*Put*" means an Option entitling, but not obligating (except upon exercise), the Buyer to sell to the Seller at the Strike Price a specified quantity of the Put Currency.

"*Put Currency*" means the Currency agreed to as such at the time an Option is entered into, as evidenced in a Confirmation.

"*Seller*" means the Party granting an Option.

"*Settlement Date*" means, in respect of: (i) an American Style Option, the Spot Date of the Currency Pair on the Exercise Date of such Option, and (ii) a European Style Option, the Spot Date of the Currency Pair on the Expiration Date of such Option; and, where market practice in the relevant foreign exchange market in relation to the two Currencies involved provides for delivery of one Currency on one date which is a Local Banking Day in relation to that Currency but not to the other Currency and for delivery of the other Currency on the next Local Banking Day in relation to that other Currency, "Settlement Date" means such two (2) Local Banking Days.

"*Specified Indebtedness*" means any obligation (whether present or future, contingent or otherwise, as principal or surety or otherwise) in respect of borrowed money, other than in respect of deposits received.

"*Specified Transaction*" means any transaction (including an agreement with respect thereto) between one Party to the Agreement (or any Credit Support Provider of such Party) and the other Party to the Agreement (or any Credit Support Provider of such Party) which is a rate swap transaction, basis swap, forward rate transaction, commodity swap, commodity option, equity or equity linked swap, equity or equity index option, bond option, interest rate option, foreign exchange transaction, cap transaction, floor transaction, collar transaction, currency swap transaction, cross currency rate swap transaction, currency option or any other similar transaction (including any option with respect to any of these transactions) or any combination of any of the foregoing.

"*Spot Date*" means the spot delivery day for the relevant Currency Pair as generally used by the relevant foreign exchange market.

"*Spot Price*" means the rate of exchange at the time at which such price is to be determined for foreign exchange transactions in the relevant Currency Pair for value on the Spot Date, as determined in good faith: (i) by the Seller, for purposes of Section 5, and (ii) by the Non Defaulting Party, for purposes of Section 8.

"*Strike Price*", in respect of any Option, means the price at which the Currency Pair may be exchanged, as agreed to at the time the Option is entered into, as evidenced in a Confirmation.

"*Terms*" means these International Currency Options Market Terms.

"*Threshold Amount*" means, as to the party, the amount specified as such by agreement in writing between the Parties or, in the absence of such an agreement, either three per cent (3%) of that Party's net worth (being its gross assets less its gross liabilities), as determined by reference to that Party's most recent published audited financial statements or, in the event that there are no, or such amount cannot be determined by reference to, published audited financial statements of the relevant Party, £ 1,000,000 (one million Pounds Sterling) or Currency equivalent.

Section 2. Options

2.1 *Scope of the Agreement.* (a) Unless otherwise agreed in writing by the Parties, each Option entered into between two Designated Offices of the Parties on or after the Effective Date shall be governed by these Terms and the particular terms agreed between the Parties in relation to that Option (b)

Each Option between any two Designated Offices of the Parties outstanding on the Effective Date which is identified by agreement in writing between the Parties for the purposes of this Section 2.1 (b) shall be an Option governed by these Terms.

2.2 *Single Agreement.* These Terms, the particular terms agreed between the Parties with respect to each Option (and, to the extent recorded in a Confirmation, each such Confirmation), and all amendments to any of such items shall together form the agreement between the Parties (the "Agreement") and shall together constitute a single agreement between the Parties. The Parties acknowledge that all Options governed by these Terms are entered into in reliance upon such fact.

2.3 *Confirmations.* Options governed by these Terms shall be promptly confirmed by the Parties by Confirmations exchanged by mail, telex, facsimile or other electronic means from which it is possible to produce a hard copy. The failure by a Party to issue a Confirmation shall not prejudice or invalidate the terms of any Option.

2.4 *Inconsistencies.* In the event of any inconsistency between any provisions agreed in writing between the Parties in relation to the Agreement and any provisions of the Agreement, the provisions agreed in writing will prevail. In the event of any inconsistency between the terms of a Confirmation and the other provisions of the Agreement, the terms of the Confirmation shall prevail, and the other terms of the Agreement shall be deemed modified with respect to such Option, except for the manner of confirmation under Section 2.3 and, if applicable, discharge of Options under Section 4.

Section 3. Option Premium

3.1 *Payment of Premium.* Unless otherwise agreed in writing by the Parties, the Buyer shall be obligated to pay the Premium related to an Option no later than its Premium Payment Date.

3.2 *Late Payment or Non Payment of Premium.* If any Premium is not received on or before the Premium Payment Date, the Seller may elect: (i) to accept a late payment of such Premium; (ii) to give written notice of such non payment and, if such payment shall not be received within two (2) Business Days of such notice, treat the related Option as void; or (iii) to give written notice of such non payment and, if such payment shall not be received within two (2) Business Days of such notice, treat such non payment as an Event of Default under clause (i) of the definition of Event of Default. If the Seller elects to act under either clause (i) or (ii) of the preceding sentence, the Buyer shall pay all out of pocket costs and actual damages incurred in connection with such unpaid or late Premium or void Option, including, without limitation, interest on such Premium from and including the Premium Payment Date to but excluding the late payment date in the same Currency as such Premium at overnight LIBOR and any other losses, costs or expenses incurred by the Seller in connection with such terminated Option, for the loss of its bargain, its cost of funding, or the loss incurred as a result of terminating, liquidating, obtaining or re establishing a delta hedge or related trading position with respect to such Option.

Section 4. Discharge and Termination of Options

If agreed in writing between the Parties, any Call or any Put written by a Party will automatically be terminated and discharged, in whole or in part, as applicable, against a Call or a Put, respectively, written by the other Party, such discharge and termination to occur automatically upon the payment in full of the last Premium payable in respect of such Options; provided that such discharge and termination may only occur in respect of Options:

(i) each being with respect to the same Put Currency and the same Call Currency;

(ii) each having the same Expiration Date and Expiration Time;

(iii) each being of the same style, i.e. either both being American Style Options or both being European Style Options;

(iv) each having the same Strike Price;

(v) each being transacted by the same pair of Designated Offices of Buyer and Seller; and

(vi) neither of which shall have been exercised by delivery of a Notice of Exercise;

and, upon the occurrence of such discharge and termination, neither Party shall have any further obligation to the other Party in respect of the relevant Options or, as the case may be, parts thereof so discharged and terminated. Such discharge and termination shall be effective notwithstanding that either Party may fail to record such discharge and termination in its books. In the case of a partial discharge and termination (i.e., where the relevant Options are for different amounts of the Currency Pair), the remaining portion of the Option which is partially discharged and terminated shall continue to be an Option for all purposes of the Agreement, including this Section 4.

Section 5. Exercise and Settlement of Options

5.1 *Exercise of Options.* The Buyer may exercise an Option by delivery to the Seller of a Notice of Exercise. Subject to Section 5.3, if a Notice of Exercise with respect to an Option has not been received by the Seller prior to or at the Expiration Time, the Option shall expire and become void and of no effect. Any Notice of Exercise shall (unless otherwise agreed):

(i) in respect of an American Style Option, (A) if received at or prior to 3:00 p.m. on a Business Day, be effective upon receipt thereof by the Seller, and (B) if received after 3:00 p.m. on a Business Day, be effective only as of the opening of business of the Seller on the first Business Day subsequent to its receipt; and

(ii) in respect of a European Style Option, if received on or, if the parties have so agreed, before the Expiration Date, prior to or at the Expiration Time, be effective upon receipt thereof by the Seller.

5.2 *No Partial Exercise.* Unless otherwise agreed by the Parties, an Option may be exercised only in whole.

5.3 *Automatic Exercise.* Unless otherwise agreed in writing between the Parties or unless the Seller is otherwise instructed by the Buyer, if an Option has an In the Money Amount at its Expiration Time that equals or exceeds the product of (x) 1% of the Strike Price (or such other percentage or amount as may have been agreed by the Parties) and (y) the amount of the Call Currency or Put Currency, as appropriate, then the Option shall be deemed automatically exercised. In such case, the Seller may elect to settle such Option either in accordance with Section 5.4 or by payment to the Buyer on the Settlement Date for such Option of the In the Money Amount, as determined at the Expiration Time or as soon thereafter as practicable. In the latter case, the sole obligations of the Parties with respect to settlement of such Option shall be to deliver or receive the In the Money Amount of such Option on the Settlement Date. The Seller shall notify the Buyer of its election of the method of settlement of an automatically exercised Option as soon as practicable after the Expiration Time.

5.4 *Settlement of Exercised Options.* An exercised Option shall settle on its Settlement Date. Subject to Section 5.3 and 5.5, on the Settlement Date, the Buyer shall pay the Put Currency to the Seller for value on the Settlement Date and the Seller shall pay the Call Currency to the Buyer for value on the Settlement Date.

5.5 *Settlement at In the Money Amount.* An Option shall be settled at its In the Money Amount if so agreed by the Parties at the time such Option is entered into. In such case, the In the Money Amount shall be determined based upon the Spot Price at the time of exercise or as soon thereafter as practicable. The sole obligations of the Parties with respect to settlement of such Option shall be to deliver or receive the In the Money Amount of such Option on the Settlement Date.

Section 6. Payment Netting

6.1 *Netting of Premiums.* If agreed in writing between the Parties and on any date, Premiums would otherwise be payable under the Agreement in the same Currency between the same respective Designated Offices of the Parties, then, on such date, each Party's obligation to make payment of any such Premium will be automatically satisfied and discharged and, if the aggregate Premium(s) that would otherwise have been payable by such Designated Office of one Party exceeds the aggregate Premium(s) that would otherwise have been payable by such Designated Office of the other Party, replaced by an obligation upon the Party by whom the larger aggregate Premium(s) would have been payable to pay the other Party the excess of the larger aggregate Premium(s) over the smaller aggregate Premium(s) and, if the aggregate Premiums are equal, no payment shall be made.

6.2 *Netting of Other Amounts.* If agreed in writing between the Parties and on any date, amounts other than Premium payments would otherwise be payable under the Agreement in the same Currency between the same respective Designated Offices of the Parties, then, on such date, each Party's obligation to make payment of any such amount will be automatically satisfied and discharged and, if the aggregate amount that would otherwise have been payable by such Designated Office of one Party exceeds the aggregate amount that would otherwise have been payable by such Designated Office of the other Party, replaced by an obligation upon the Party by whom the larger aggregate amount would have been payable to pay the other Party the excess of the larger aggregate amount over the smaller aggregate amount.

Section 7. Representations, Warranties and Covenants

7.1 *Representations and Warranties.* Each Party represents and warrants to the other Party as of the date of the Agreement and as of the date of each Option governed by these Terms that: (i) it has authority to enter into the Agreement (including such Option); (ii) the persons entering into the Agreement (including such Option) on its behalf have been duly authorized to do so; (iii) the Agreement (including such Option) is binding upon it and enforceable against it in accordance with its terms (subject to applicable bankruptcy, reorganization, insolvency, moratorium or similar laws affecting creditors' rights generally and applicable principles of equity) and does not and will not violate the terms of any agreements to which such Party is bound; (iv) no Event of Default, or event which, with notice or lapse of time or both, would constitute an Event of Default, has occurred and is continuing with respect to it; (v) it acts as principal in entering into and exercising each and every Option governed by these Terms ; and (vi) if the Parties have so agreed in writing, it makes the representations and warranties set out in such Agreement in writing between the Parties.

7.2 *Covenants.* Each Party covenants to the other Party that: (i) it will at all times obtain and comply with the terms of and do all that is necessary to maintain in full force and effect all authorizations, approvals, licenses and consents required to enable it lawfully to perform its obligations under the Agreement; (ii) it will promptly notify the other Party of the occurrence of any Event of Default with respect to itself or any Credit Support Provider in relation to it; and (iii) if the Parties have agreed in writing, it makes such additional covenants.

Section 8. Close Out and Liquidation

8.1 *Manner of Close Out and Liquidation.*

(a) *Close Out of Options.* If an Event of Default has occurred and is continuing, then the Non Defaulting Party shall have the right to close out all, but not less than all, outstanding Options, except to the extent that in the good faith opinion of the Non Defaulting Party certain of such Options may not be closed out under applicable law. Such close out shall be effective upon receipt by the Defaulting Party of notice that the Non Defaulting Party is terminating such Options. Notwithstanding the foregoing, unless otherwise agreed in writing between the Parties, in the case of an Event of Default specified in clauses (ii), (iii) or (iv) of the definition thereof with respect to such Party and any other Event of Default

agreed as envisaged in clause (xiii) of the definition of Events of Default with respect to such Party, such close out shall be automatic as to all outstanding Options, as of the time immediately preceding the institution of the relevant Insolvency Proceeding or action. The Non Defaulting Party shall have the right to liquidate such closed out Options as provided below.

(b) *Liquidation of Options*. Liquidation of Options terminated by close out shall be effected as follows:

(i) the Non Defaulting Party shall calculate in good faith with respect to each such terminated Option, except to the extent that in the good faith opinion of the Non Defaulting Party certain of such Options may not be liquidated as provided herein under applicable law, as of the Close Out Date or as soon as reasonably practicable thereafter a settlement amount for each Party equal to the aggregate of:

(A) with respect to each Option purchased by such Party, and which the other Party has not elected to treat as void pursuant to Section 3.2(ii) for lack of payment of the Premium, the current market premium for such Option;

(B) with respect to each Option sold by such Party and which such Party has not elected to treat as void pursuant to Section 3.2(ii) for lack of payment of the Premium, any unpaid Premium, provided that, if the Close Out Date occurs before the Premium Payment Date, such amount shall be discounted from and including the Premium Payment Date to but excluding the Close Out Date at a rate equal to LIBOR on the Close Out Date and, if the Close Out Date occurs after the Premium Payment Date, to the extent permitted by applicable law, the settlement amount shall include interest on any unpaid Premium from and including the Premium Payment Date to but excluding the Close Out Date in the same Currency as such Premium at overnight LIBOR;

(C) with respect to any exercised Option (whether or not the Close Out Date occurs before the Settlement Date for such Option), any unpaid amount due to such Party in settlement of such Option and, if the Close Out Date occurs after the Settlement Date for such Option, to the extent permitted by applicable law, interest thereon from and including the applicable Settlement Date to but excluding the Close Out Date at overnight LIBOR; and

(D) without duplication, the amount that the Non Defaulting Party reasonably determines in good faith, as of the Close Out Date or as of the earliest date thereafter that is reasonably practicable, to be its additional losses, costs and expenses in connection with such terminated Option, for the loss of its bargain, its cost of funding, or the loss incurred as a result of terminating, liquidating, obtaining or re establishing a delta hedge or related trading position with respect to such Option;

(ii) converting any settlement amount calculated in accordance with clause (i) above in a Currency other than the Non Defaulting Party's Base Currency into such Base Currency at the Spot Price at which, at the time of the calculation, the Non Defaulting Party could enter into a contract in the foreign exchange market to buy the Non Defaulting Party's Base Currency in exchange for such Currency (or, if such Spot Price is not available, conversion shall be accomplished by the Non Defaulting Party using any commercially reasonable method); and

(iii) netting such settlement amounts with respect to each Party so that all such amounts are netted to a single liquidated amount payable by one Party to the other Party as a settlement payment.

8.2 *Set Off Against Credit Support*. Where close out and liquidation occurs in accordance with Section 8.1, the Non Defaulting Party shall also be entitled (i) to set off the net payment calculated in accordance with clause (iii) of Section 8.1 which the Non Defaulting Party owes to the Defaulting Party, if any, against any credit support or other collateral ("Credit Support") held by the Defaulting Party pursuant to a Credit Support Document or otherwise (including the liquidated value of any non cash Credit Support) in respect of the Non Defaulting Party's obligations under the Agreement or (ii) to set off the net payment calculated in accordance with such clause (iii) which the

Defaulting Party owes to the Non Defaulting Party, if any, against any Credit Support held by the Non Defaulting Party (including the liquidated value of any non cash Credit Support) in respect of the Defaulting Party's obligations under the Agreement; provided that, for purposes of either such set off, any Credit Support denominated in a Currency other than the Non Defaulting Party's Base Currency shall be converted into such Currency at the rate specified in clause Section 8.1(b)(ii) .

8.3 *Other Option Transactions.* Where close out and liquidation occurs in accordance with Section 8.1, the Non Defaulting Party shall also be entitled to close out and liquidate, to the extent permitted by applicable law, any other currency option entered into between the Parties which are then outstanding (including exercised options not fully performed) in accordance with the provisions of Section 8.1, as if each option were an Option under the Agreement.

8.4 *Payment and Late Interest.* The net amount payable by one Party to the other Party pursuant to the provisions of Sections 8.1 and 8.3 above shall be paid by the close of business on the Business Day following the receipt by the Defaulting Party of notice of the Non Defaulting Party's settlement calculation, with interest at overnight LIBOR from and including the Close Out Date to but excluding such Business Day (and converted as required by applicable law into any other Currency, any costs of conversion to be borne by, and deducted from any payment to, the Defaulting Party). To the extent permitted by applicable law, any amounts owed but not paid when due under this Section 8 shall bear interest at overnight LIBOR (or, if conversion is required by applicable law into some other Currency, either overnight LIBOR with respect to such other Currency or such other rate as may be prescribed by such applicable law) for each day for which such amount remains unpaid. Any addition of interest or discounting required under this Section 8 shall be calculated on the basis of a year of such number of days as is customary for transactions involving the relevant Currency in the relevant foreign exchange market.

8.5 *Suspension of Obligations.* Without prejudice to the foregoing, so long as a Party shall be in default in payment or performance to the other Party under the Agreement and the other Party has not exercised its rights under this Section 8, the other Party may, at its election and without penalty, suspend its obligation to perform under the Agreement.

8.6 *Expenses.* The Defaulting Party shall reimburse the Non Defaulting Party in respect of all out of pocket expenses incurred by the Non Defaulting Party (including fees and disbursements of counsel, including attorneys who may be employees of the Non Defaulting Party) in connection with any reasonable collection or other enforcement proceedings related to the payments required under the Agreement.

8.7 *Reasonable Pre Estimate.* The Parties agree that the amounts recoverable under this Section 8 are a reasonable pre estimate of loss and not a penalty. Such amounts are payable for the loss of bargain and the loss of protection against future risks and, except as otherwise provided in the Agreement, neither Party will be entitled to recover any additional damages as a consequence of such losses.

8.8 *No Limitation of Other Rights; Set Off.* The Non Defaulting Party's rights under this Section 8 shall be in addition to, and not in limitation or exclusion of, any other rights which the Non Defaulting Party may have (whether by agreement, operation of law or otherwise), and, to the extent not prohibited by law, the Non Defaulting Party shall have a general right of set off with respect to all amounts owed by each Party to the other Party, whether due and payable or not due and payable (provided that any amount not due and payable at the time of such set off shall, if appropriate, be discounted to present value in a commercially reasonable manner by the Non Defaulting Party). The Non Defaulting Party's rights under this Section 8.8 are subject to Section 8.7.

Section 9. Force Majeure, Act of State, Illegality and Impossibility

9.1 *Force Majeure, Act of State, Illegality and Impossibility.* If either Party is prevented from or hindered or delayed by reason of force majeure or act of state in the delivery or receipt of any Currency in respect of an Option or if it becomes, or, in the good faith judgment of one of the Parties, may become unlawful or impossible for either Party to make or receive any payment in respect of an Option, then the Party for whom such performance has been prevented, hindered or

delayed or has become illegal or impossible shall promptly give notice thereof to the other Party and either Party may, by notice to the other Party, require the close out and liquidation of each affected Option in accordance with the provisions of Section 8.1 and, for such purposes, the Party unaffected by such force majeure, act of state, illegality or impossibility (or, if both Parties are so affected, whichever Party gave the relevant notice) shall perform the calculation required under Section 8.1 as if it were the Non Defaulting Party. Nothing in this Section 9.1 shall be taken as indicating that the Party treated as the Defaulting Party for the purpose of calculations required by Section 8.1 has committed any breach or default.

9.2 *Transfer to Avoid Force Majeure, Act of State, Illegality or Impossibility.* If Section 9.1 becomes applicable, unless prohibited by law, the Party which has been prevented, hindered or delayed from performing shall, as a condition to its right to designate a close out and liquidation of any affected Option, use all reasonable efforts (which will not require such Party to incur a loss, excluding immaterial, incidental expenses) to transfer as soon as practicable, and in any event before the earlier to occur of the expiration date of the affected Options or twenty (20) days after it gives notice under Section 9.1, all its rights and obligations under the Agreement in respect of the affected Options to another of its Designated Offices so that such force majeure, act of state, illegality or impossibility ceases to exist. Any such transfer will be subject to the prior written consent of the other Party, which consent will not be withheld if such other Party's policies in effect at such time would permit it to enter into transactions with the transferee Designated Office on the terms proposed, unless such transfer would cause the other Party to incur a material tax or other cost.

Section 10. Parties to Rely on Their Own Expertise

Each Party will be deemed to represent to the other Party on the date on which it enters into an Option governed by these Terms that (absent a written agreement between the Parties that expressly imposes affirmative obligations to the contrary for that Option): (i)(A) it is acting for its own account, and it has made its own independent decisions to enter into that Option and as to whether that Option is appropriate or proper for it based upon its own judgement and upon advice from such advisors as it has deemed necessary; (B) it is not relying on any communication (written or oral) of the other Party as investment advice or as a recommendation to enter into that Option, it being understood that information and explanations related to the terms and conditions of an Option shall not be considered investment advice or a recommendation to enter into that Option; and (C) it has not received from the other Party any assurance or guarantee as to the expected results of that Option; (ii) it is capable of evaluating and understanding (on its own behalf or through independent professional advice), and understands and accepts, the terms, conditions and risks of that Option; and (iii) the other Party is not acting as a fiduciary or an advisor for it in respect of that Option.

Section 11. Miscellaneous

11.1 *Currency Indemnity.* The receipt or recovery by either Party (the "first Party") of any amount in respect of an obligation of the other Party (the "second Party") in a Currency other than that in which such amount was due, whether pursuant to a judgment of any court or pursuant to Section 8 or 9, shall discharge such obligation only to the extent that, on the first day on which the first Party is open for business immediately following such receipt or recovery, the first Party shall be able, in accordance with normal banking practice, to purchase the Currency in which such amount was due with the Currency received or recovered. If the amount so purchasable shall be less than the original amount of the Currency in which such amount was due, the second Party shall, as a separate obligation and notwithstanding any judgment of any court, indemnify the first Party against any loss sustained by it. The second Party shall in any event indemnify the first Party against any costs incurred by it in making any such purchase of Currency.

11.2 *Assignment.* Neither Party may assign, transfer or charge or purport to assign, transfer or charge its rights or obligations under the Agreement to a third party without the prior written consent of the other Party and any purported assignment, transfer or charge in violation of this Section 11.2 shall be void.

11.3 *Telephonic Recording*. The Parties agree that each may electronically record all telephonic conversations between them and that any such recordings may be submitted in evidence to any court or in any Proceedings for the purpose of establishing any matters pertinent to the Agreement.

11.4 *Notices*. Unless otherwise agreed, all notices, instructions and other communications to be given to a Party under the Agreement shall be given to the address, telex (if confirmed by the appropriate answer back), facsimile (confirmed if requested) or telephone number and to the individual or department specified by notice in writing to such Party. Unless otherwise specified, any notice, instruction or other communication given in accordance with this Section 11.4 shall be effective upon receipt.

11.5 *Termination*. Each of the Parties may terminate the Agreement at any time by seven (7) days' prior written notice to the other Party delivered as prescribed in Section 11.4, and termination shall be effective at the end of such seventh day; provided, however, that any such termination shall not affect any outstanding Options, and the provisions of the Agreement shall continue to apply until all the obligations of each Party to the other under the Agreement have been fully performed.

11.6 *Severability*. In thc event any one or more of the provisions contained in the Agreement should be held invalid, illegal or unenforceable in any respect under the law of any jurisdiction, the validity, legality and enforceability of the remaining provisions contained in the Agreement under the law of such jurisdiction, and the validity, legality and enforceability of such and any other provisions under the law of any other jurisdiction shall not in any way be affected or impaired thereby. The Parties shall endeavour in good faith negotiations to replace the invalid, illegal or unenforceable provisions with valid provisions the economic effect of which comes as close as possible to that of the invalid, illegal or unenforceable provisions.

11.7 *No Waiver*. No indulgence or concession granted by a Party and no omission or delay on the part of a Party in exercising any right, power or privilege under the Agreement shall operate as a waiver thereof, nor shall any single or partial exercise of any such right, power or privilege preclude any other or further exercise thereof or the exercise of any other right, power or privilege.

11.8 *Master Agreement*. Where one of the Parties to the Agreement is domiciled in the United States, the Parties intend that the Agreement shall be a master agreement, as referred to in 11 U.S.C. Section 101(53B)(C) and 12 U.S.C. Section 1821(e)(8)(D)(vii).

11.9 *Time of Essence, et cetera*. Time shall be of the essence in the Agreement. Unless otherwise agreed, the times referred to in the Agreement shall in each case refer to the local time of the relevant Designated Office of the Seller of the relevant Option.

11.10 *Headings*. Headings in the Agreement are for ease of reference only.

11.11 *Payments Generally*. All payments to be made under the Agreement shall be made in same day (or immediately available) and freely transferable funds and, unless otherwise specified, shall be delivered to such office of such bank, and in favour of such account as shall be specified by the Party entitled to receive such payment in a notice given in accordance with Section 11.4.

11.12 *Amendments*. No amendment, modification or waiver of the Agreement will be effective unless in writing executed by each of the Parties; provided that the Parties may agree in a Confirmation that complies with Section 2.3 to amend the Agreement solely with respect to the Option that is the subject of the Confirmation.

11.13 *Credit Support*. A Credit Support Document between the Parties may apply to obligations governed by the Agreement. If the Parties have executed a Credit Support Document, such Credit Support Document shall be subject to the terms of the Agreement and is hereby incorporated by reference in the Agreement. In the event of any conflict between a Credit Support Document and the Agreement, the Agreement shall prevail, except for any provision in such Credit Support Document in respect of governing law.

Section 12. Law and Jurisdiction

12.1 *Governing Law.* The Agreement shall be governed by, and construed in accordance with, the laws of England and Wales.

12.2 *Consent to Jurisdiction.*

(a) With respect to any Proceedings, each Party irrevocably (i)agrees for the benefit of the other Party to submit to the jurisdiction of the courts of England and Wales and (ii) waives any objection which it may have at any time to the laying of venue of any Proceedings brought in any such court, waives any claim that such Proceedings have been brought in an inconvenient forum and further waives the right to object, with respect to such Proceedings, that such court does not have jurisdiction over such Party. Nothing in the Agreement precludes either Party from bringing Proceedings in any other jurisdiction nor will the bringing of Proceedings in any one or more jurisdictions preclude the bringing of Proceedings in any other jurisdiction.

(b) Each Party irrevocably appoints the agent for service of process (if any) specified by notice in writing to the other Party. If for any reason any Party's process agent is unable to act as such, such Party will promptly notify the other Party and within thirty (30) days will appoint a substitute process agent acceptable to the other Party.

12.3 *Waiver of Jury Trial.* Each Party irrevocably waives any and all right to trial by jury in any Proceedings.

12.4 *Waiver of Immunities.* Each Party irrevocably waives, to the fullest extent permitted by applicable law, with respect to itself and its revenues and assets (irrespective of their use or intended use), all immunity on the grounds of sovereignty or other similar grounds from (i) suit, (ii) jurisdiction of any court, (iii) relief by way of injunction, order for specific performance or for recovery of property, (iv) attachment of its assets (whether before or after judgment) and (v) execution or enforcement of any judgment to which it or its revenues or assets might otherwise be entitled in any Proceedings in the courts of any jurisdiction and irrevocably agrees, to the extent permitted by applicable law, that it will not claim any such immunity in any Proceedings.

SIGNING SHEET

Parties wishing to record their entry into a Master Agreement on these Master Agreement Terms in hard copy form may use the signing section to create their Master Agreement.

If this signing section is utilised, the heading sheet, to be found at the beginning of this Master Agreement Terms on page 36, should also be completed.

IN WITNESS WHEREOF, the Parties have caused the Agreement to be duly executed by their respective authorised officers as of the date first written above.

By;

Title:

By;

Title:

Schedule of Certain Matters to be Agreed

Part I. *Scope of the Agreement*

The Agreement shall apply to [all] [the following] currency options outstanding between any two Designated Offices of the Parties on the Effective Date.

Part II. *Designated Offices*

Each of the following shall be a Designated Office:

Party A:

Party B:

Part III. *Notices*

If sent to Party A:

Address:
Telephone Number:
Telex Number:
Facsimile Number:
Name of Individual or Department to whom Notices are to be sent:

If sent to Party B:

Address:
Telephone Number:
Telex Number:
Facsimile Number:
Name of Individual or Department to whom Notices are to be sent:

Part IV. *Payment Instructions*

☐ Name of Bank and Office, Account Number and Reference with respect to relevant Currencies

☐ With respect to each Party, as may be set forth in such Standard Settlement Instructions as may be specified by such Party in a notice given in accordance with Section 11.4.

Part V. *Netting*

A. *Discharge of Options*

Section 4 [shall] [shall not] apply to Options.

B. *Netting of Premiums*

Section 6.1 [shall] [shall not] apply to Premium payments.

C. *Netting of Other Amounts*

Section 6.2 [shall] [shall not] apply to amounts other than Premium payments.

Part VI. *Automatic Exercise of Options*

Automatic Exercise of certain In the Money Options pursuant to Section 5.3 [shall] [shall not] apply to Party A as Buyer.

Automatic Exercise of certain In the Money Options pursuant to Section 5.3 [shall] [shall not] apply to Party B as Buyer.

Part VII. *Base Currency*

Party A's Base Currency is

Party B's Base Currency is

Part VIII. *Threshold Amount*

For purposes of clause (x) of the definition of Event of Default:

Party A's Threshold Amount is [$]

Party B's Threshold Amount is [$]

Part IX. *Additional Events of Default*

The following provisions which are checked shall constitute Events of Default:

☐ (a) occurrence of garnishment or provisional garnishment against a claim against the Defaulting Party acquired by the Non Defaulting Party. The automatic termination provision of Section 8.1 [shall][shall not] apply to either Party that is a Defaulting Party in respect of this Event of Default.

☐ (b) suspension of payment by the Defaulting Party or any Credit Support Provider in accordance with the Bankruptcy Law or the Corporate Reorganization Law in Japan. The automatic termination provision of Section 8.1 [shall][shall not] apply to either Party that is a Defaulting Party in respect of this Event of Default.

☐ (c) disqualification by Defaulting Party or any Credit Support Provider by any relevant bill clearing house located in Japan. The automatic termination provision of Section 8.1 [shall][shall not] apply to either Party that is a Defaulting Party in respect of this Event of Default.

Part X. *Automatic Termination*

The Automatic Termination provision of Section 8.1 [shall][shall not] apply to Party A.

The Automatic Termination provision of Section 8.1 [shall][shall not] apply to Party B.

Part XI. *Adequate Assurances*

Adequate Assurances under Section 11.14 [shall][shall not] apply to the Agreement.

Part XII. *Governing Law*

In accordance with Section 12.1 of the Agreement, the Agreement shall be governed by the laws of:

☐ the State of New York.

☐ England and Wales.

☐ Japan.

Part XIII. *Consent to Jurisdiction*

In accordance with Section 12.2 of the Agreement, each Party irrevocably submits to the non exclusive jurisdiction of:

☐ the courts of the State of New York and the United States District Court located in the Borough of Manhattan in New York City.

☐ the courts of England.

☐ the Tokyo District courts.

Part XIV. *Agent for Service of Process*

[Not applicable]

[Party A appoints the following as its agent for service of process in any Proceedings in [the State of New York][England and Wales] [Japan]:]

[Party B appoints the following as its agent for service of process in any Proceedings in [the State of New York][England and Wales] [Japan]:]

Part XV. *Certain Regulatory Representations*

A. The following FDICIA representation [shall][shall not] apply:

1. Party A represents and warrants that it qualifies as a "financial institution" within the meaning of the Federal Deposit Insurance Corporation Improvement Act of 1991 ("FDICIA") by virtue of being a:
   - ☐ broker or dealer within the meaning of FDICIA;
   - ☐ depository institution within the meaning of FDICIA;
   - ☐ futures commission merchant within the meaning of FDICIA;
   - ☐ "financial institution" within the meaning of Regulation EE (see below).
2. Party B hereby represents and warrants that it qualifies as a "financial institution" by virtue of being a:
   - ☐ broker or dealer within the meaning of FDICIA;
   - ☐ depository institution within the meaning of FDICIA;
   - ☐ futures commission merchant within the meaning of FDICIA;
   - ☐ "financial institution" within the meaning of Regulation EE (see below).
3. A Party representing that it is a "financial institution" as that term is defined in 12 C.F.R. Section 231.3 of Regulation EE issued by the Board of Governors of the Federal Reserve System ("Regulation EE") represents that:
   (a) it is willing to enter into "financial contracts" as a counterparty "on both sides of one or more financial markets" as those terms are used in Section 231.3 of Regulation EE and
   (b) during the 15 month period immediately preceding the date it makes or is deemed to make this representation, it has had on at least one (1) day during such period, with counterparties that are not its affiliates (as defined in Section 231.2(b) of Regulation EE) either:
      (i) one or more financial contracts of a total gross notional principal amount of $1 billion outstanding; or
      (ii) total gross mark to market positions (aggregated across counterparties) of $100 million; and
   (c) agrees that it will notify the other Party if it no longer meets the requirements for status as a financial institution under Regulation EE.
4. If both Parties are financial institutions in accordance with the above, the Parties agree that the Agreement shall be a netting contract, as defined in 12 U.S.C. Section 4402(14), and each receipt or payment or delivery obligation under the Agreement shall be a covered contractual payment entitlement or covered contractual payment obligation, respectively, as defined in FDICIA.

B. The following ERISA representation [shall][shall not] apply:

Each Party represents and warrants that it is neither (i) an "employee benefit plan" as defined in Section 3(3) of the Employee Retirement Income Security Act of 1974 which is subject to Part 4 of Subtitle B of Title I of such Act; (ii) a "plan" as defined in Section 4975(e)(1) of the Internal Revenue Code of 1986; nor (iii) an entity the assets of which are deemed to be assets of any such "employee benefit plan" or "plan" by reason of the U.S. Department of Labor's plan asset regulation, 29 C.F.R. Section 2510.3 101.

C. The following CFTC trade option representation [shall][shall not] apply:

Each Party represents and warrants that it is a commercial user of or a merchant handling the Currencies subject to each Option and was offered or entered into each Option solely for purposes related to its business as such.

D. The following CFTC eligible swap participant representation [shall][shall not] apply:

Each Party represents and warrants that it is an "eligible swap participant" under, and as defined in, 17 C.F.R. Section 35.1.

Part XVI. *Additional Covenants*

The following covenant[s] shall apply to the Agreement:

Barrier Options Addendum to the International Currency Options Master Agreement Terms

The Schedule to the Master Agreement Terms is amended by adding the following Part XVII:

The following additional terms shall govern Barrier Options transacted between the Parties.

1. **Definitions.**

Unless otherwise specified in a Confirmation, the following terms when used in a Confirmation shall have the meanings set forth below.

"Barrier Option" means a Knock In Option or a Knock Out Option.

"Barrier Determination Agent" means the Party who determines whether or not a Knock in Event or Knock Out Event has occurred and shall be either the Buyer or Seller or a third person as agreed at the time the Barrier Option is entered into.

"Barrier Period" means, unless otherwise agreed, the period commencing on the date and at the time the Barrier Option is entered into and ending at the Expiration Time on the Expiration Date.

"Exercise Time Window" means a period on the Expiration Date commencing one hour prior to the Expiration Time and ending at the Expiration Time, during which exercise of a Knock Out Option may be made as referred to in paragraph 4.1 below.

"Initial Spot Rate" means the spot rate at the time a Barrier Option is entered into, as evidenced in a Confirmation.

"In Strike Price" means that Spot Price (for the Currency Pair which is the subject of a Knock In Option) agreed to as such between the Parties as evidenced in a Confirmation.

"Knock In Event", with respect to a Knock In Option, means that, at any time during the Barrier Period, the Spot Exchange Rate is equal to or beyond the In Strike Price as determined by the Barrier Determination Agent, acting in good faith and in a commercially reasonable manner.

"Knock In Option" means an Option which may only be exercised in the event that a Knock In Event has occurred.

"Knock Out Event", with respect to a Knock Out Option, means that, at any time during the Barrier Period, the Spot Exchange Rate is equal to or beyond the Out Strike Price, as determined by the Barrier Determination Agent, acting in good faith and in a commercially reasonable manner provided that, if an Exercise Time Window is applicable, the Barrier Period shall be deemed to end at the time during the Exercise Time Window when the Option is exercised.

"Knock Out Option" means an Option which may only be exercised if no Knock Out Event has occurred.

"Out Strike Price" means that Spot Price (for the Currency Pair which is the subject of a Knock Out Option) agreed as such between the Parties as evidenced in a Confirmation.

"Spot Exchange Rate" means the price, at the time at which such price is to be determined, in the Spot Market for foreign exchange transactions involving the Currency Pair which is the subject of the Option determined by reference either to rates for the exchange of the Currencies in such Currency Pair or to cross rates, as the Barrier Determination Agent shall determine acting in good faith and in a commercially reasonable manner.

"Spot Market" means the global spot foreign exchange market, which, for these purposes, shall, unless otherwise agreed, be treated as being open continuously from 6:00 a.m. Sydney time on a Monday in any week to 5:00 p.m. New York time on the Friday of that week.

2. **Notification of Knock In/Out Event.** The Barrier Determination Agent shall promptly notify the other Party (or Parties if the Barrier Determination Agent is not a Party) of the occurrence of a Knock In or Knock Out Event, as the case may be, in relation to a Barrier Option. A failure to give such notice shall not however prejudice or invalidate the occurrence or effect of the Knock In Event or Knock Out Event.

3. **Exercise and Settlement.**

3.1 (a) If an Exercise Time Window is applicable, a Knock Out Option may be exercised at any time during the Exercise Time Window, provided that no Knock Out Event has occurred at or prior to exercise.

(b) If an Exercise Time Window is not applicable, a Knock Out Option may be exercised only on the Expiration Date at the Expiration Time and provided that no Knock Out Event has occurred at or prior to exercise. Notice of exercise may be given prior to the Expiration Time but shall be effective only as at the Expiration Time and provided that no Knock Out Event has occurred at or prior to the Expiration Time.

(c) A Knock In Option may be an American or European Style Option, as agreed by the Parties, as evidenced in a Confirmation. In either event, a Knock In Option may be exercised only if a Knock In Event has occurred prior to any such exercise.

3.2 Unless otherwise agreed, an exercised Barrier Option shall be settled on its Settlement Date by the payment by each Party to the other of the full amount of either the Put Currency or Call Currency, as the case may be, subject to the Barrier Option.

4. **Discharge and termination of Barrier Options.** The provisions in Section 4 of the Master Agreement Terms relating to discharge and termination of options [shall] [shall not] be applicable to Barrier Options. If such provisions are applicable to Barrier Options, in addition to the conditions specified in such provisions, Barrier Options satisfying such conditions shall not be discharged and terminated unless the Barrier Determination Agent is the same for both Barrier Options.

Example of Short Form Knock Out/Knock In Currency Option Confirmation

Date: (DD MMM YY)

To: Ref No.:

From: Telephone: Reuters Code:
Facsimile: Telex:

We confirm we have entered into the following [Knock Out][Knock In] Option with you, as an Option under the ICOM Master Agreement Terms. This Option has features that differ from a standard currency option as a result of which it may only be exercised if [no Knock Out][a Knock In] Event has occurred in relation to it.

Trade Date and Time	:
Initial Spot Rate	:
Buyer	:
Seller	:
[Out Strike][In Strike] Price	:
Barrier Determination Agent	: [Insert full name]
Exercise Time Window [Knock Outs only]	: None/One Hour
Option Style	: [European][American]
Call Currency and Amount	:
Put Currency and Amount	:
Strike Price	:
Expiration Date	:
Expiration Time	:
Settlement Date	:
Premium	:
Premium Payment Date	:
Premium Payment Instructions	:
Other terms:	:

This constitutes a "Confirmation" as referred to in the Master Agreement Terms. Capitalised terms used herein within definitions have the meanings set forth in the Master Agreement Terms. In the event of any inconsistency between the Master Agreement Terms and the provisions of this Confirmation, this Confirmation will govern.

Please confirm to us by return telex, mail, facsimile or other electronic transmission that the above details are correct.

Example of Long Form Knock Out/Knock In Currency Option Confirmation

Date: (DD MMM YY)

To: Ref No.:

From: Telephone: Reuters Code:
Facsimile: Telex:

We confirm that we have entered into the following [Knock-In][Knock-Out] Option (this "Option") with you, effective as of the date and time indicated below. As may be applicable, this Option shall be subject to

the terms of any Option Agreement/Terms (as defined below). In addition, this Option shall be subject to the Additional Terms set forth below in this confirmation.

You should be aware that this Option has features that differ from a standard currency option as a result of which it may only be exercised if [a Knock-In] [no Knock-Out] Event (as defined below) has occurred in relation to it.

Trade Date and Time	:
Initial Spot Rate	:
Buyer	:
Seller	:
[In-Strike][Out-Strike] Price	:
Barrier Determination Agent	: [Insert full name]
Exercise Time Window	: [None][One Hour] [Knock-Outs only]
Option Style	: [European][American]
Call Currency and Amount	:
Put Currency and Amount	:
Strike Price	:
Expiration Date	:
Expiration Time	:
Settlement Date	:
Premium	:
Premium Payment Date	:
Premium Payment Instructions	:
Other Terms and Conditions:	:

Additional Terms

1. *Definitions*

"Barrier Determination Agent" means the party who determines whether or not a [Knock-In][Knock-Out] Event has occurred and shall be either the Buyer or Seller or a third person as agreed at the time this Option was entered into.

"Barrier Period" means, unless otherwise agreed, the period commencing on the date and at the time this Option was entered into and ending at the earlier of the Expiration Time on the Expiration Date or the occurrence of the [Knock-Out Event/ Knock-In Event].

[for Knock-Outs only]["Exercise Time Window" means a period on the Expiration Date commencing one hour prior to the Expiration Time and ending at the Expiration Time, during which exercise of a Knock-Out Option may be made as referred to in paragraph 3.1 below.]

"Initial Spot Rate" means the applicable Spot Exchange Rate at the time this Option was entered into, as evidenced above.

[for Knock-Ins only]["In-Strike Price" means that Spot Price (for the Currency Pair which is the subject of this Option) agreed to as such between the parties as evidenced above, which is the price at which a Knock-In Event will be deemed to have occurred.]

[for Knock-Ins only]["Knock-In Event" means that, at any time during the Barrier Period, the Spot Exchange Rate is equal to or beyond the In-Strike Price as determined by the Barrier Determination Agent, acting in good faith and in a commercially reasonable manner.]

[for Knock-Outs only]["Knock-Out Event" means that, at any time during the Barrier Period, the Spot Exchange Rate is equal to or beyond the Out-Strike Price, as determined by the Barrier Determination Agent, acting in good faith and in a commercially reasonable manner; provided

that, if an Exercise Time Window is applicable, the Barrier Period shall be deemed to end at the time during the Exercise Time Window when this Option is exercised.]

"Option Agreement/Terms" means (i) where the two parties have entered into a master agreement governing currency options transactions between the offices of the parties to this Option (such master agreements include, without limitation, the International Currency Options Market Master Agreement, the International Swaps and Derivatives Association Master Agreement or any other master agreement relating to currency options, in each case as from time to time amended or supplemented), the applicable master agreement; or (ii) where the parties have not entered into any master agreement which governs this Option and the designated office of each party to this Option is located in England, the International Currency Options Market Terms issued by the British Bankers Association (the "BBA Terms") dated August 1992 (as from time to time amended, supplemented or replaced), the applicable BBA Terms.

[for Knock-Outs only]["Out-Strike Price" means that Spot Price (for the Currency Pair which is the subject of this Option) agreed as such between the parties, as evidenced above, which is the price at which a Knock-Out Event will be deemed to have occurred.]

"Spot Date" means the spot delivery day for the relevant Currency Pair as generally used by the foreign exchange market.

"Spot Exchange Rate" means the price, at the time at which such price is to be determined, for value on the applicable Spot Date in the Spot Market for foreign exchange transactions involving the Currency Pair which is the subject of this Option determined by reference either to rates for the exchange of the Currencies in such Currency Pair or to cross rates, as the Barrier Determination Agent shall determine acting in good faith and in a commercially reasonable manner.

"Spot Market" means the global spot foreign exchange market, which, for these purposes, shall, unless otherwise agreed, be treated as being open continuously from 6:00 a.m. Sydney time on a Monday in any week to 5:00 p.m. New York time on the Friday of that week.

2. *Notification of Knock-In/Out Event.*

The Barrier Determination Agent shall promptly notify the other party (or parties if the Barrier Determination Agent is not a party) of the occurrence of a [Knock-In][Knock-Out] Event in relation to this Option. A failure to give such notice shall not however prejudice or invalidate the occurrence or effect of the [Knock-In] [Knock-Out] Event.

3. *Exercise and Settlement.*

3.1 [for Knock-Outs only][(a) If an Exercise Time Window is applicable, this Option may be exercised at any time during the Exercise Time Window, provided that no Knock-Out Event has occurred at or prior to exercise.]

[for Knock-Outs only][(b) If an Exercise Time Window is not applicable, exercise of this Option is effective only on the Expiration Date at the Expiration Time and provided that no Knock-Out Event has occurred at or prior to the Expiration Time. Notice of exercise may be given prior to the Expiration Time but shall be effective only as of the Expiration Time and provided that no Knock-Out Event has occurred at or prior to the Expiration Time.]

[for Knock-Ins only][This Option may be an American or European Style Option, as agreed by the parties, as indicated herein. In either event, this Option may be exercised only if a Knock-In Event has occurred prior to any such exercise.]

3.2 Unless otherwise agreed, if exercised, this Option shall be settled on its Settlement Date by the payment by each party to the other of the full amount of either the Put Currency or Call Currency, as the case may be.

[3.3 If applicable, the provisions of the Option Agreement/Terms which provide for the offset of identical options shall not apply to this Option.]

[If applicable, insert disclosure language relating to the effects of foreign exchange trading of a party on the barrier]

This confirmation constitutes a "Confirmation" as referred to in the Option Agreement/Terms. Capitalized terms used herein within definitions have the meanings set forth in the Option Agreement/Terms, including any Schedules thereto. In the event of any inconsistency between this confirmation and the terms and conditions of the Option Agreement/Terms, this confirmation shall prevail. Please review the terms and conditions set forth in this confirmation and confirm to us by return telex, mail, facsimile or other electronic transmission that the above details are correct.

[PARTY A]

By ________________________
Name:
Title:

THE TERMS OF THIS CONFIRMATION ARE
ACCEPTED AND AGREED TO AS OF
THE TRADE DATE ABOVE:

[PARTY B]

By ________________________
Name:
Title:

Example of Currency Option Confirmation

Date: (DD MMM YY)To: Ref No.:

From: Telephone: Reuters Code:
Facsimile: Telex:

We confirm we have entered into the following Currency Option with you, as an Option under the ICOM Master Agreement Terms.

Trade Date:
Buyer:
Seller:
Option Style (European or American):
Option Type (Put or Call):
Put Currency and Amount:
Call Currency and Amount:
Strike Price:
Expiration Date:
Expiration Time:
Expiration Settlement Date:
Premium:
Price:
Premium Payment Date:
Premium Payment Instructions:
Other terms and conditions:

This constitutes a "Confirmation" as referred to in the Master Agreement Terms. Capitalised terms used herein within definitions have the meanings set forth in the Master Agreement Terms. In the event of any inconsistency between the Master Agreement Terms and the provisions of this Confirmation, this Confirmation will govern.

Please confirm to us by return telex, mail, facsimile or other electronic transmission that the above details are correct.

BBA Contact Numbers

The Currency Options Market is dynamic and rapidly changing. Should you wish to discuss any issues of policy or market practice please contact a member of the BBA Executive.

Listed below are executives responsible for policy areas related to the Currency Option Market. They can be contacted by dialling + 44 (0) 171 216 followed by the following extensions:

Financial Markets	Bob Blower	8855
	Ronit Ghose	8856
	Simon Hills	8861
EMU	Roger Brown	8838
Risk Management	William Mason	8857
	John Thirlwell	8862
Banking Supervision	Peter Vipond	8859
	Richard Quinn	8858
Financial Reporting	Paul Chisnall	8865
Taxation	Paul Tipping	8868

If you have general queries on the work of the BBA, please contact the appropriate executive listed below:

Communications	Roger Miles	8809
	Brian Capon	8810
Membership & Policy	Catherine Sweet	8872
BBA MEMBER HELP DESK	0171 216 8822	

Comments

**INTERNATIONAL CURRENCY OPTIONS
MASTER AGREEMENT TERMS**

The BBA welcomes any comments or suggestions you would like to make on the Terms included in this Booklet. It is our intention to update this Booklet as the Currency Options Market develops. Any comments received from practitioners could be incorporated in future editions.

Please send your comments to:

Simon Hills, British Bankers' Association, Pinners Hall, 105-108 Old Broad Street, London EC2N 1EX.

Index

all-or-nothing option, see digital options
American option, **12**, 49, 223, 234, 247
Asian option, see average rate option
at-the-money (ATM), 14, 39, 55, 58, 87, 114, 143, 247
average rate (Asian, avro) option, **145–50**, 248
  summary, **150**
  variations, **149**
  weighted average rate option, **149–50**
average strike option, **150–1**, 248
avro, see average rate option

banks, relationships, **133–9**
  guidelines for good relationships, **137**
  is price all that matters? **137**
  the dealer, **135**
  the salesperson, **133**
barrier (trigger) options, 4, **151–78**, 188, 231-6, 248
  determination of spot touching, **172**
  double barriers, **176**
  knock-in (down & in), **163**
  knock-in (up & in), **159**
  knock-out (down & out), **156–7**
  knock-out (up & out), **153**
  parity, **166**
  pricing, **168**
  reverse down & in, **165**
  reverse down & out, **159**
  reverse up & in, **162**
  reverse up & out, **156**
  summary, **177**
  terminology, **169**
  variations, **175**
  with rebate, 171, **199**
barrier determination, 172-3, 222, 231-2
basket option, **179–80**, 248
bear spread, 78, 248-9
Bermudan option, 249
bet option, see digital options
beta, 124, 248
binary option, see digital options
binomial model, 48, 249
Black-Scholes, 1, **47–8**, 53, 102, 169, 262
bonus (break) forward, **201**
bull spread, **77–8**, 250
butterfly, **123**, 250

calendar spread, 55-6, 58, **123–4**, 250
call option (vanilla), **10–11**, 18, 103-4, 251. See also option, calls & puts
call spread, **123**, 250
Capital Adequacy Directive, 250
cash settlement, 46, **146**, 149, 179, 251
charm, 251
Code of Conduct, The London, 5, 29, 139
collar, see risk reversal
colour, 251
compound option, **141–4**
confirmations, 137, 218, **235–45**
contingent option, **204–8**
counterparty credit risk, 28, 79, 228, **245–55**
  foreign exchange limits, **236**
  margins, **244**
  master agreements, **245**
  maximum daily delivery risk (MDDR), **237**
  maximum outstanding (credit line), **236**
  netting, **238**
  revaluation, mark-to-market, risk, **237**
  risk factors, **240**
covered call write, 44, 72, 252
cylinder, see risk reversal

delayed start option, see forward start option
delta, **101–12**, 128, 188, 242, 253
  definition, **102**
  hedging principles, **108**
  understanding the delta, **102–5**
designing a strategy, **95**
digital (binary, bet) options, **182–96**
  at-expiry (European), all-or-nothing, **182**
  combinations, **192**
  double digital barriers, **194**
  double digitals (range binaries), **189–91**
  for hedging, **183**
  instant one-touch, **186**
  no-touch, **185**
  one-touch, **184**
  option methodology, **186**
  pricing, **188**
  strike & barrier (digital barriers), **194**
  summary, **195**
documentation, **216–34**
drop-in option, knock-in option. See barrier (trigger) options
drop-out option, knock-out option. See barrier (trigger) options

European option, **12**, 14, 27, 32, 40, 104, 117, 152
exchange listed, **31–8**
  advantages & disadvantages, **36**
  brokers, **33**
  comparison with OTC, **36**
  contract specifications, **33**
  electronic trading (Globex2), **35**
  location, **31**
  margins, **34**
  products, **33**
  regulation, **33**
  specialisation, **34**
  summary, **35**
  trading practices, **31**
  transaction size & volume, **34**
exercise, 11, **125–6**, 254
  of knock-out option, **232**
exotic options, listed individually by name, see average rate/strike, barrier (trigger), basket, compound, contingent, digital (binary), forward start, lookback (optimal)
expiration (maturity), 11, 224-6, 254

FENICS, 64-5, 67, 84, 90, 95, 170-1, 178, 213-15, 224, 254
FEOMA, see master agreements
foreign exchange (FX), **7–8**, 16
forward start option, **144–5**

gamma, **111–12**, 149, 214, 255

health, **170**, 256
hedge ratio, see delta
hedging, using options for
  advanced, **181–207**
  designing a strategy, **95**
  intermediate, **140–80**
  naked, **110**
  risk manipulation, **99**
  simple, **68–100**

ICOM, see master agreements
IFEMA, see master agreements
interim value of options, See options, interim value
in-the-money (ITM), **14**, 56, 256
intrinsic value, **51**
ISDA, see master agreements

kappa, see vega
kick-in option, knock-in option. See barrier (trigger) options
kick-out option, knock-out option. See barrier (trigger) options
knock-in option, see barrier (trigger) options
knock-out option, see barrier (trigger) options

lambda, 257
LICOM, see master agreements
lookback (optimal) option, **178**

margins, **34**, 258
marketplace, the, **26–38**
  corporate market, **128**
  exchange listed, **31**
  OTC market practices, **113–32**
  over-the-counter, **26**
master agreements
  FEOMA, 218, 220, 245
  ICOM, 5, 29, 127, 137, 174-5, **220–34**, 244-5, 256
  IFEMA, 218, **220**
  ISDA, 5, 29, 137, 216, 219, **220**, 231, 257
  LICOM, 3, 5, **217**, 258
  market preference, 231
  summary, 230
maturity, see expiration

netting, 118, 229, **238–40**

omega, 259
option
  call & put, **10–11**, 18-20, 39-45, 68
  characteristics, **16–25**
  combinations, 20
  definition, **9**
  exercise, 11, **125–6**, 254
  face value, **10**
  interim value, **23–4**, 208
  premium, **9**
  pricing, **46–67**
  replication, **109**
  short (sold), **21**, 71
  strike, **13**
  style, **12**
  underlying position, **24**
  volatility, see volatility, traded or implied
out-of-the-money (OTM), **14**, 56, 259
over-the-counter, see marketplace, the

participating forward, **84–90**, 96, 260
path dependent, 150, 260
premium, see option, premium
pricing, **47–67**
  Black-Scholes, **47**
  components of price, **51**
  components of time value, **53**
  input factors, **48**
  intrinsic value, **53**
  is price all that matters? **137**
  systems, **64**
  summary, **66**
  terms, **62**
  time value adjustment through volatility, **58**
  time value effects, **54–8**
  time value, **52**
  volatility, **49**
profit sharing forward, see participating forward
put option (vanilla), **19**, 20, 25, 39, 68, 261
put spread, **123**, 250
put-call parity, **39–46**

range binary, see double digital
range forward, see risk reversal
ratio spread, 261, see participating forward
replication, see option, replication
risk control, **208–15**
  other risk measures, **214**
  sensitivity to spot, **210**
  sensitivity to spot & volatility, **211**
  software, **215**
  value at risk (VAR), **213**

risk manipulation, **99**
risk-reversal, **74–84**, 96, 122, 201, 262

seagull, **90**, 96, 262
sigma, see vega
skew (of volatility), see volatility
smile (of volatility), see volatility
software, option, 64, 84, 90, 95, 131, **215**
speed, **263**
stealth, **171**, 263
straddle, **20**, 116, 263
strangle, **122**, 263
strike, see option, strike
synthetic options & positions, **39–43**

theta, 210, **264**

time value, **52–8**

up & in option, knock-in option. See barrier (trigger) options
up & out option, knock-out option. See barrier (trigger) options

value at risk (VAR), see risk control
vega, 125, 144, 168, 214, **266**
volatility, traded or implied, **49–51**, 58-62, 114-25, 129
- how to compare quotes, **129**
- maturity curve, **61**
- quoting & dealing, **114–25**, 129
- skew, **60**
- smile, **59**

wealth, **170**, 265